PEDIATRICS
ILLUSTRATED

Mostafa Zakaria

NEW EDITION

PEDIATRICS
ILLUSTRATED

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Growth and development

Definition

- Growth: increase in mass and dimension of the body, it includes aspects as weight, length and head circumference.

- Development: maturation of functions and gaining of various skills, it includes aspects as motor development, mental development and sexual development.
  Both growth and development go parallel to each other.

Growth stages

- **Prenatal (Intrauterine stage)**
  1. **Embryonic stage:** The first 8 weeks.
  2. **Fetal stage:**
     - Early: 9-24 weeks.
     - Late: 25- 40 weeks.

Early fetal stage

Late fetal stage

- **Postnatal (extra uterine stage)**
  1. **Neonates:** first 4 weeks of life or the first month of life.
  2. **Infancy:** from one month to 2 years.
  3. **Childhood**:
     - Early childhood (preschool): 2-6 years.
     - Late childhood (school): 6-12 years.
  4. **Adolescence:** 12-20 years

Factors affecting physical growth

- **Pre-natal factors**

1. **Genetic factors**
   Growth rate is controlled by certain genes; children inherit their height and body frame from their parents.

2. **Race**
   There is racial difference in rate and pattern of growth. The Chinese for example, have height lower than other races, So it is better for every country to use its growth curves.

- **Postnatal factors: S NEC S** . . . . .

1. **Sex**
   Girls grow faster than boys from7 months till 4 years and start puberty at a younger age than boys. So there are growth curves for boys and other for girls.
2. **Nutritional status**
   Under nutrition delay growth while over nutrition lead to obesity

3. **Endocrinal factors**
   Growth hormone, thyroid hormone, insulin and androgens all affect growth.
4. **Chronic illness** e.g. chronic renal, liver or chest diseases delay growth.
5. **Socioeconomic factors**
   Poor housing
   Poor hygiene and poor health all retard growth.

Poor housing, poor hygiene and poor health

Growth hormone deficiency

Aspects of normal growth and development

- Physical growth
- Motor development
- Mental development
- Sexual development : see puberty P

Physical growth

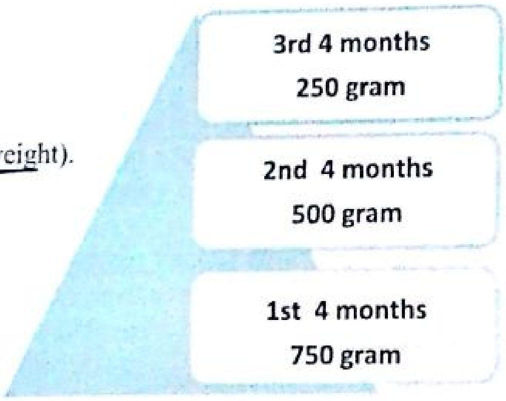
1. Weight.
2. Height and length. Body proportions: upper segment to lower segment ratio
3. Skull circumference.
4. Anterior fontanel.
5. Dentition.
6. Bone age (skeletal maturity).
7. Vital signs.

شفوى هام جداً الـ Growth Curves.

Weight

⊛ الـ Weight change in Rapid علشان كده أول حاجة بشوفها لما آجي أعمل monitor to growth

- **At birth**: 2.500: 4 Kg. (average: 3 kg).
- **During the first year of life:**
  - × **First 4 months: 3/4 kg /month.**
    - 1 month: 3.750 kg
    - 2 months: 4.500
    - 3 months: 5.250
    - 4 months: 6.000 (double birth weight).
  - × **Second 4 months: 1/2 kg/ month.**
    - 5 months: 6.500 kg
    - 6 months: 7.000
    - 7 months: 7.500
    - 8 months: 8.000
  - × **Third 4 months: 1/4 Kg / month.**
    - 9 months: 8.250 Kg
    - 10 months: 8.500
    - 11 months: 8.750
    - 12 months: 9.000 kg (3 times birth weight)
  - × Birth weight is doubled at *4 months* and tripled at *1year*



- **During early childhood 2-6 years:** 2 kg/ year. Weight = (Age in years X 2 +8).
  - 2 years: 12 kg
  - 3 years: 14
  - 4 years: 16
  - 5 years: 18
  - 6 years: 20
- **During late childhood (7-12 years):** 2.5 kg/year.
  - 7 years: 22.5 Kg
  - 10 years: 30 (ten times birth weight)

2-6 years
2 kg/year

7-12 years
2.5 kg/year

Length and height

- Under **3 years** the length is measured in supine position.
- Over **3 years** height is measured in standing position.

- **At birth**: 50 cm
- **During the first 4 years**
  - 6 months: 68 cm
  - 1 year: 75 cm
  - 2 years: 87 cm
  - 3 years: 94 cm
  - 4 years: 100 cm (double birth length)

5o cm At birth

75 cm at 1 year

100 at 4 years

- **Between 4-8 years, the height increases about 7 cm/year**
- **Between 9-12 years, the height increases about 5 cm/year**
- **Height is doubled at 4 years and tripled at 12 year**

Age in years X 5 + 80

* **Body proportions (upper segment / lower segment)**

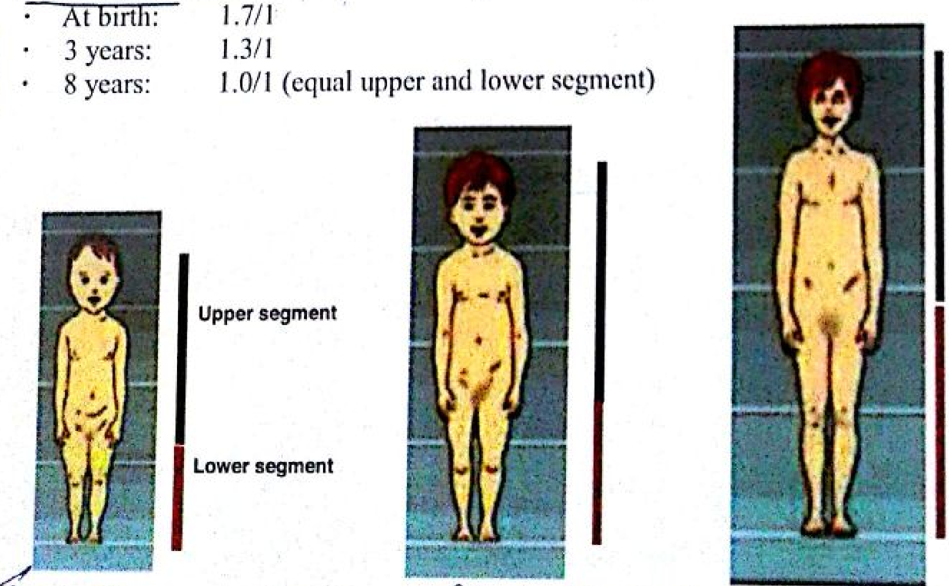
Lower segment is measured from symphysis pupis to the feet.

Upper segment is obtained by subtracting the lower segment from the total height.

From symphysis Pupis to the crown.

- At birth: 1.7/1
- 3 years: 1.3/1
- 8 years: 1.0/1 (equal upper and lower segment)

عظم ال long Bones فيها epiphysis يطول أسرع



مشاكل في ال epiphysis ← Achondroplesia → affect the lower segment

الأقزام

[illegible]
Remodeling
(15)

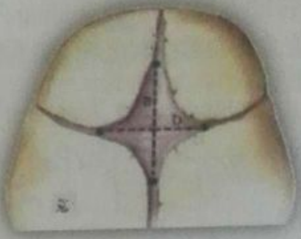
Head circumference

- At birth: 35 cm.
- 6 months: 43 cm. +8
- 1 year: 47 cm. + 4
- 12 cm during the first year.
- 2 years: 49 cm +2
- 4 years: 50 cm.
- 6 years: 51 cm
- 12 years: 53 cm.
- 6 cm only during 11 years.

Fontaneles

- **Anterior** 3 adult fingers (side to side)
  - At birth: 3 fingers : 5 cm width
  - 6 months: 2 fingers
  - 1 year : 1 finger
  - 1.5 years: Closed
- **Posterior:** Closed at birth.

عكس يتقفل قبل سنة ونص عادي أهم حاجة ال Head circumference يكون ماشي كويس.



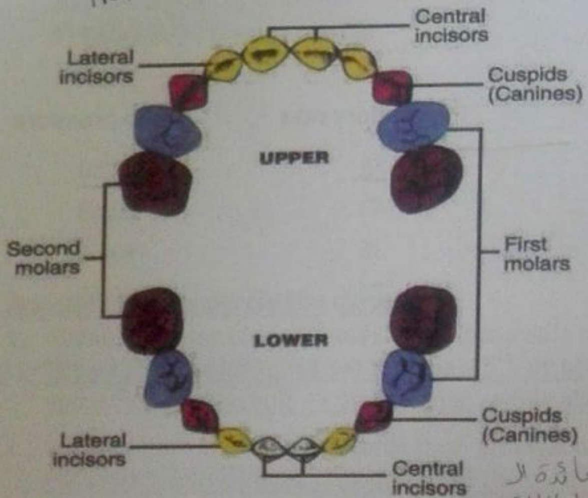
Dentition

بتقع / اتشاكل بسرعة

- **Primary or Deciduous teeth** milk teeth → ⑳ (Temporal teeth)
  - Central incisors 6 mon 5-7 months
  - Lateral incisors 8 mon 7-9 months
  - First molar 1 Year 10-16 months
  - Canines 1.5 Years 16-20 months
  - Second molar 2 Years 20-30 months.

(*) Canines take alot of time to erupt ?! → Deep

Teething in the lower jaw precedes the upper by 1-2 months.
However there wide range of variation ←



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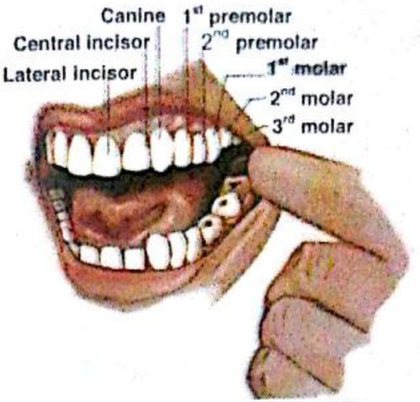
فائدة ال milk teeth → Guide and adjust the Permenant teeth

- **Secondary or permanent teeth** (32) teeth

First molar	6-7 years
Central incisor	6-7 years
Lateral incisor	7-8 years
First premolar	10-12 years
Second premolar	11-13 years
Canine	9- 11 years
Second molar	12-13 years
Third molar	17-22 years



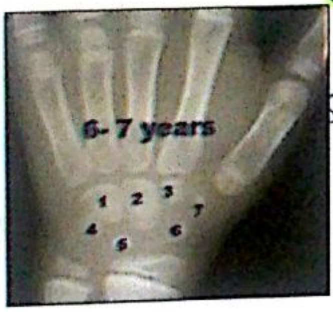
Skeletal maturity: radiological determination of bone age.

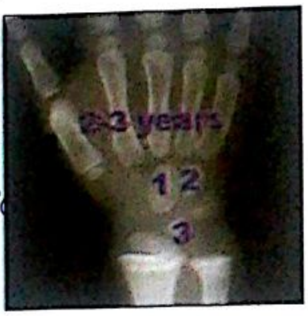
Bone is derived by Hormones.
→
* GH
* Thyroid
* Androgen

- **Simple determination of bone age**
  - Can be made by considering the time of appearance of ossific centers and then fusion of the epiphysis.
  - **At birth**: ossific centers around the knee joint are well developed.
  - **In early childhood (2- 6 years): x ray of the hand and wrist**: roughly, there is one ossific carpal center per year.
  - **In late childhood and adolescence** : fusion of epiphysis

* 1st Carpal bone at 6 month
وبعدين واحدة ت ossify زيادة كل سنة
1 Year = 2 ossifi center

عمر الطفل بيكون أقل من ال Carpal Bones بواحد
يعني لو في ال X-ray لـ 7 Carpal يبقى عمره 6 Years





- **Accurate determination of bone age** can be made by atlases as Tanner

Normally bone age corresponds to the age of the child. In growth retardation, there is delay in bone age e.g. hypothyroidism and growth hormone deficiency.

مرضية CXLP → Delayed / Advanced Bone age.

Vital signs

	Heart rate	Respiratory rate	Blood pressure
مولود → Newborn	130	55	80/60
6 months	120	40	80/60
1 year	120	35	80/60
4 years	100	25	80/60
10 years	90	20	110/65

Abnormal is outside (±2SD) ← ⊛ Standard deviation curves
• Velocity curves
بتاع ال٩٥ > ← • Percentile Growth curves

WR®

Growth Curves (charts)

Background

- There is wide range of variations among normal children of the same age.
- Each child has his own inherited pattern of growth.

So growth curves are essential to

- Demonstrate the normal growth variations.
- Summarize the growth data → earlier diagnosis of abnormal growth e.g. short stature

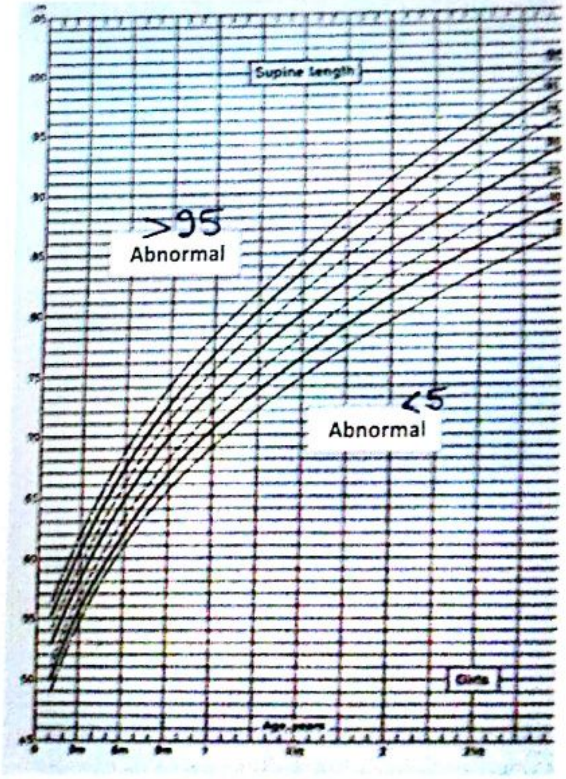
Percentile growth curves are the most commonly used.

- **Criteria of curves**
  1. Made for different aspects of physical growth: height, weight and skull circumference.
  2. Percentile curves vary from:
     - Boys to girls (charts for boys and other for girls are available).
     - One country to another (charts for Egyptian children are now available).
     - Age: charts for the first 36 months and charts from children 2 -20 years.
  3. Each chart is composed of 7 percentile curves:
     50th percentile represents the average and it indicates that 50 % of normal children are below this value.

95th percentile: highest normal
90th percentile: high normal
75th percentile: above average

* **50th percentile: average**

25th percentile: below average
10th percentile: low normal
5th percentile: Lowest normal



- **Normal child on percentile curves**
  1. Should lie between the 5th and the 95th percentile curves
     On single measurement: values below 5th or above 95th are abnormal e.g. weight under the 5th percentile → underweight, while above 95th → overweight.
  2. Should follow the same percentile level throughout the growth period
     On serial measurements: deviation of the child from his own percentile curve is abnormal.

For screening ← مين normal ومين لأ

⊛ Catch up:- If a child with under growth accelerate his growth rate back to normal.

MCQ

Motor development during infancy: gross skills

At birth

Turns head from side to side

3 months

Head support in sitting position

4 months

Pushes with feet

6-7 months

Sits without support

6 months

Palmer grasp

8 months

Rolling over

9 months

Crawling

10 months

Pincer grasp

10 months

Standing

12 months

Walks (holding on to furniture)

15 months

Walks alone steady

MCQ

Motor development during early childhood

1½ year

Ascends stairs in a child manner (step by step) – runs stiffly

2 years

Descends stairs in a child manner and runs well

3 years

Ascends stairs in an adult manner (alternate steps) – can pedal tricycle

4 years

Descends stairs in an adult manner

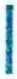
5 years

Can hop on one feet

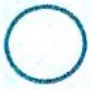
6 years

Can dress himself
Can draw triangle , square

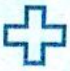
Drawing



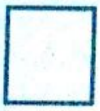
2 years



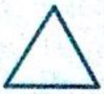
3 yeras



4 years



41/2 years



< 5 years

Mental development during Infancy (Social development)

1 months

Follows moving objects or light

2 months

Smiles on social contact (social smile)

3 months

Listens to music

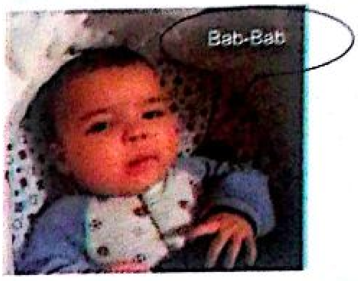
4 months

Laughs and prefers social contact

6 months

Recognizes his mother

8 months



Babbling

9 months

Responds to own name
Says Mama, Dada

12 months

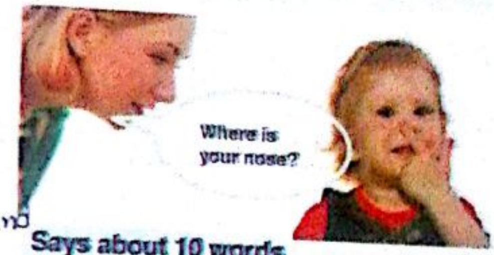
Waves bay – bay
Plays simple ball game

Mental development during early childhood: Speech development

1 year

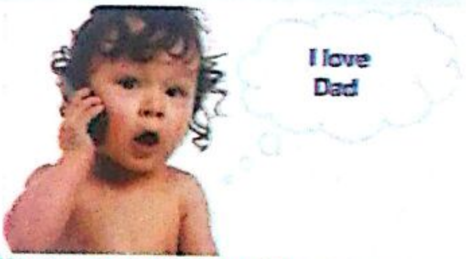
Says only 2-3 words غير apart from (Dad) and (Mom)
Understands several words

1 ½ year


Where is your nose?

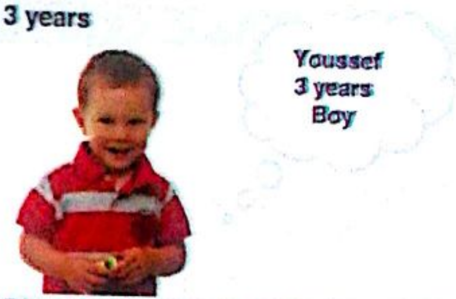
Says about 10 words
Shows 2 parts of the body

2 years



Knows about 100 words
Says 3 words sentence (telegraphic) without أفعال غالباً ← "ماما كورة" يعني "ماما عايز الكورة" مثلاً

3 years



Gives full name, age and sex

4 years

False story
Fantasia

Tells story – counts up to 10
Recognizes 8 colors

5 years

What is this?

Clear and fluent speech
Asks about meaning of words

Mental development during late childhood : learning ability

A normal 6 years old child can draw a man with all features (Draw –A- man test)

Abnormal Growth And Development

مهم

Short stature

Definition

A height below the 5^{th} h percentile for age and sex.

Etiology

Normal variants: more than 90%

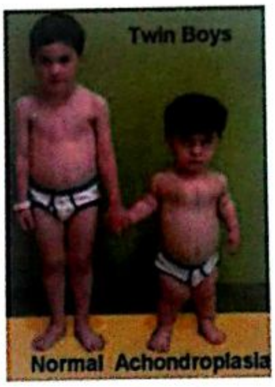
1. Familial short stature	2. Constitutional delay of growth and puberty
. The commonest cause of short stature	Common problem in boys in secondary school age
. Short parents	. Normal parents
. Short healthy subjects	. History of delayed growth in childhood
. Normal growth velocity.	. Delay in the pubertal phase
. Normal bone age	. Delayed bone age
. Normal hormonal pattern	. Normal hormonal pattern
. Final height is short and falls within the mid parental height	. Final height is normal
. Family history of short stature	. Family history of delay in pubertal phase
Reassurance is what needed	

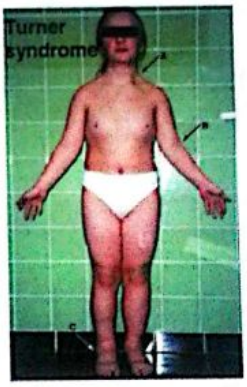
Bone age and Puberty are friends.

Pathological: less than 10%

1. **Genetic and chromosomal disorders**

- Down syndrome.
- Turner syndrome: (discuss shortly)
- Mucopolysaccharidosis.
- Skeletal dysplasia: e.g. achonroplasia.





2. **Severe systemic diseases in infancy and childhood**

- Renal diseases: chronic renal failure.
- Respiratory: Tuberculosis
- Chronic hemolytic anemia.
- Chronic hepatic disease.
- Celiac disease and other malabsorption syndromes

* طول الطفل/طول والده ووالدته
* systemic / genetalla examination
* upper and lower segment → proportionate or Not

3. Endocrinal causes

- **Growth hormone deficiency**
  - Panhypopituitarism e.g. craniopharngioma (rare but must be excluded).
  - Isolated growth hormone deficiency.
  - Insulin growth factor 1(IGF1) deficiency
  - IGF1 receptor defect.
- **Juvenile hypothyroidism**
- **Others**
  - Cushing syndrome.
  - Adrenal insufficiency.
  - Hypoparathyroidism.
  - Corticosteroid therapy (dose more than 5 mg/day.) for prolonged period - alternate day single dose allows normal growth

4. Nutritional starvation (malnutrion)

Malnutrition diminishes synthesis of growth factors which mediates the peripheral; anabolic effects of growth hormone.

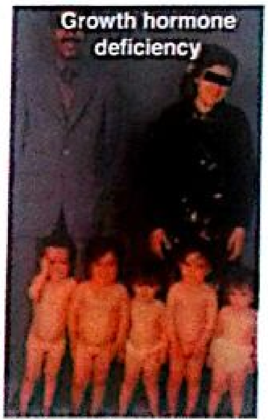
Clinical evaluation and Investigation

History

1. Family history of short stature or delayed puberty.
2. History of any chronic illness.

Examination

1. Measurements
   - Length of the parent and sibs. Most cases are familial.
   - Length of the child and upper segment: lower segment ratio.
   - Height velocity follows up
2. Detailed systemic examination to exclude systemic causes.
3. Genital examination and pubertal staging.



Particular attention should be given for:-

1. Cases with severe short stature (height less than 5th percentile).
2. Cases whose parental height suggests that they should be above the 5th centile.
3. Cases in whom serial measurement show progressive deviation from normal

لا بأس عليكِ.. هونًا

Investigations

Laboratory

1. Karyotyping → Turner syndrome (45 XO).
2. Hormonal profile: cortisol, thyroid profile
3. Calcium, phosphorus and alkaline phosphatase.
4. Growth hormone: it is unnecessary to subject children to assay until they have at least 6-12 months of height velocity follow up.

Imaging

1. Bone age determination (x ray wrist) to differentiate familial short stature from constitutional delay of growth and puberty, it is normal in familial short stature.
2. Skeletal survey in skeletal dysplasia
3. CT and MRI brain to exclude pituitary gland lesions e.g. craniopharyngioma.

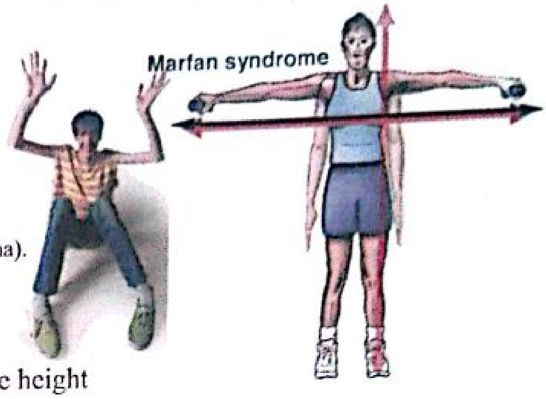
لا بأس

*Causes of Delayed Dentition (P: 8 كتاب القسم) شفوى
*Causes of Delayed Closure of fontanelles ↑

Tall stature

Definition

Height above 95th percentile for age and sex



Etiology

1. **Proportionate**
   - Genetic or familial.
   - Endocrinal
     - Growth hormone excess (pituitary adenoma).
     - Precocious puberty.
     - With simple obesity.
2. **Disproportionate (non endocrinal)**
   - Marfan syndrome: arm span exceeds the height

Abnormalities of head growth

Microcephaly and craniostenosis : P 229 → ⊛ clinical Evaluation of microcephaly in general [P: 7 كتاب القسم]

Macrocephaly

WR Ⓑ oral

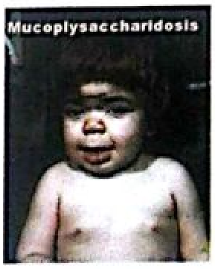
Macrocephaly

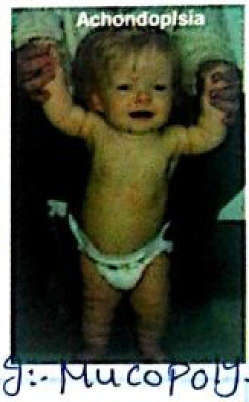
* لما يجي السؤال ده WR تكتب لهم عن ال clinical picture بتاعه ⊙

Definition

It is head circumference above the 95th percentile for age and sex.

Etiology





1. **Cranial causes**
   - Familial large head.
   - ⊙ Chronic hemolytic anemia.
   - ⊙ Rickets.
   - Achonroplasia and mucoplysaccharidosis
2. **Intracranial (increased intracranial tension)**
   - ⊙ Hydrocephalus.
   - Subdural hematoma and Subdural effusion.
   - Brain tumors.
   - Neurofibromatosis
   - Cerebral gigantism
   - CNS Storage disorders e.g.:- Mucopolysaccharidosis

Abnormalities of weight

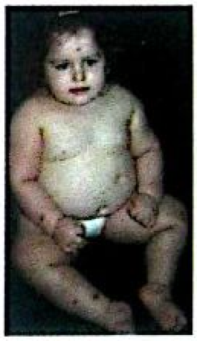
Underweight: causes of marasmus: P48

Overweight (obesity)

Obesity

Definition

BMI (body mass index) ≥ 95TH percentile
(BMI: weight in Kg / height in square meter)


Prader –Willi S

Etiology

1. Exogenous obesity genetic and environmental factors
2. Endogenous obesity.
   - Cushing syndrome.
   - Turner syndrome.
   - Klinefelter syndrome and Prader –Willi syndrome

Puberty

Definition

Period of life characterized by morphological and physiological changes, which, occur in the growing boy or girl as the gonads change from their infantile to adult state.

Age of onset of puberty

It varies according to genetic, racial, socioeconomic and nutritional factors.
In developed countries:-

- Boys 9-14 years
- Girls 8-13 years

The principle manifestations of puberty

- The adolescent growth spurt: acceleration followed by a decleration of growth, terminated by epiphyseal fusion and final adult stature
- Development of the gonads
- Development of secondary sexual characters
- Adolescence psychological behavioral changes

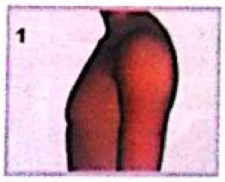
Stages of puberty

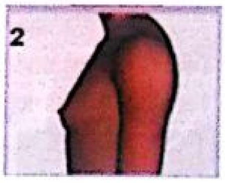
Sexual maturity rating in girls

1. **Breast development**: (controlled by estrogen)

Stage 1 Preadolescent :elevation of papilla only

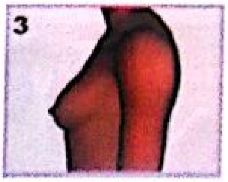
Stage 2 Breast bud stage :elevation of breast and papilla as a small mound ,enlargement of the areolar diameter

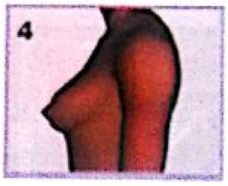




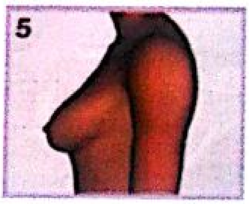
Stage 3 Further enlargement of breast and areola with no separation of their contours

Stage 4 Projection of areola and papilla to form a secondary mound above the level of the breast



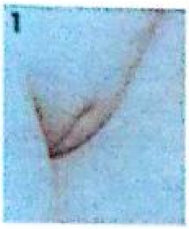


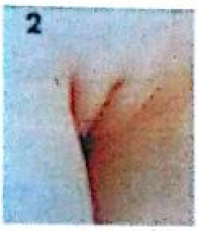
Stage 5 Mature stage: projection of nipple – areola part of general breast contour

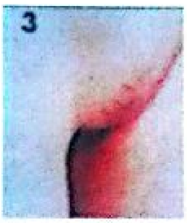


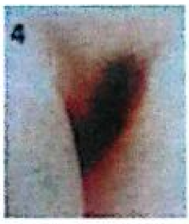
2. **Pubic hair** (controlled by adrenal androgen)

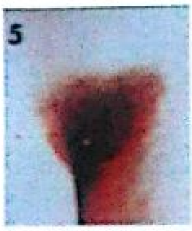
Stage 1	Preadolescent: no pubic hair.
Stage 2	Sparse growth of pubic hair appearing mainly along the labia.
Stage 3	Hair is darker and spread over pubis.
Stage 4	Hair is adult in type (coarse and curly).
Stage 5	Hair is adult in type and quantity, distributed as an inverse triangle.











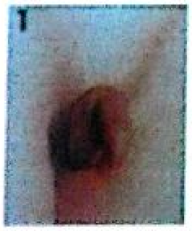
3. **Axillary hair** (controlled by adrenal androgen): males and females are the same

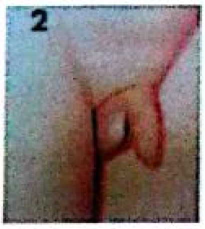
Stage 1	No axillary hair
Stage 2	Appearance of axillary hair
Stage 3	Adult type

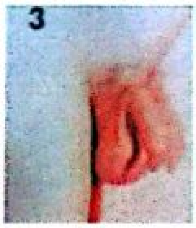
Sexual maturity rating in boys

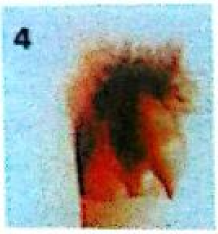
1. **Testicular volume (measured by orchiodemeter) and penis**

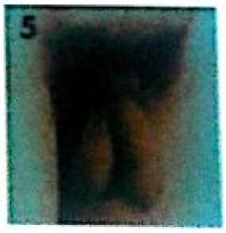
Stage 1	Preadolescent testicular size 1,2,3 - Preadolescent penis size
Stage 2	Testicular volume 4 - Slight enlargement of the penis
Stage 3	Testicular volume 5,6,7- Longer penis
Stage 4	Testicular volume 8,10- Further growth of penis
Stage 5	Testicular volume 15 - adult size penis

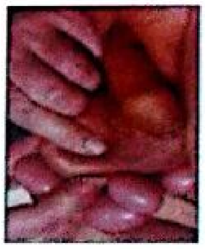


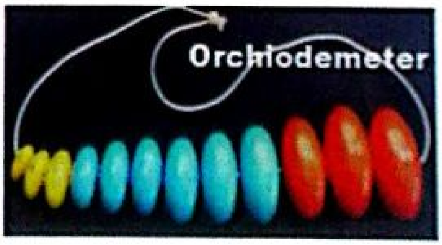












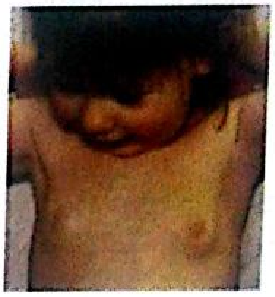
2. **Pubic hair**

Stage 1	Preadolescent : no pubic hair
Stage 2	Sparse growth of pubic hair mainly at the base of the penis
Stage 3	Hair is darker and spread over the junction of the pubis
Stage 4	Hair is adult in type
Stage 5	Hair is adult in quantity and type, spread to the medial thighs

Precocious puberty

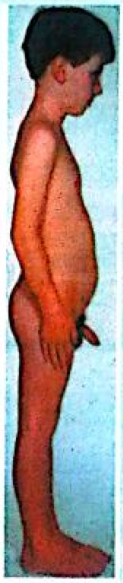
Definition

Onset of puberty before 8 years in girls or before 9 years in boys



Types

1. **Normal variant**
   - Premature thelarche in girls
     - Simple breast development at the age of 1-4 years.
     - No other signs of puberty and it regresses spontaneously
   - Gynecomastia in boys
     - The commonest cause is pubertal gynecomastia that occurs in 30-60% of boys at time of puberty.
     - It should be differentiated from local causes(tumors or excess fat)
   - Premature adrenarche
     - Pubic hair development before the age of puberty due earlier maturation of adrenal androgens.
     - Adrenal hyperplasia or an adrenal tumor must be excluded



2. True precocious puberty(central)	3. Pseudo precocious puberty
Characters	**Characters**
. It involves hypothalamic -pituitary gonadal activation	. It does not involve hypothalamic pituitary activation
. High gonadotropin level	. Normal gonadotropin level (prepubertal)
. It involves both secondary sexual characters and increase in the size and activity of the gonads.	. It involves only secondary sexual characters, gonads don't increase in size
. Spermatogenesis occurs in male and ovulation occurs in female	. Spermatogenesis in male and ovulation in female don't occur.
Etiology	**Etiology**
Idiopathic(mainly in girls): the commonest Secondary (commoner in boys) e.g. . Brain tumors- hydrocephalus. . Trauma and radiotherapy.	. Girls: ovarian tumors or excess estrogen . Boys: testicular tumors or excess androgens

Delayed puberty

Definition

Failure to develop secondary sexual characters by 13 years in girls or 14 years in boys.

Types

1. **Hypogonadotropic hypogonadism:** (FSH, LH) and sex steroids are low.
   Etiology: Kallman syndrome- CNS radiation, hypothalamic or pituitary lesions
2. **Hypergonadotropic hypogonadism:** .Increased FSH and low sex steroids
   Etiology: Turner and Klinefelter syndromes- (undescended testes or orchitis)
3. **Constitutional delay of growth and puberty**: see short stature: P 12

*Karyotyping: Study of number, size and shape of the chromosomes in a single human cell.

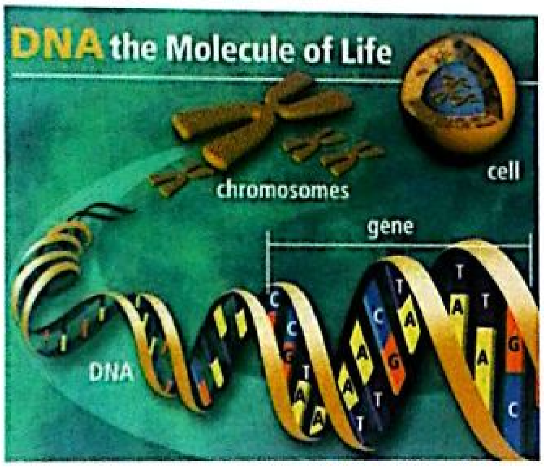
Genetics

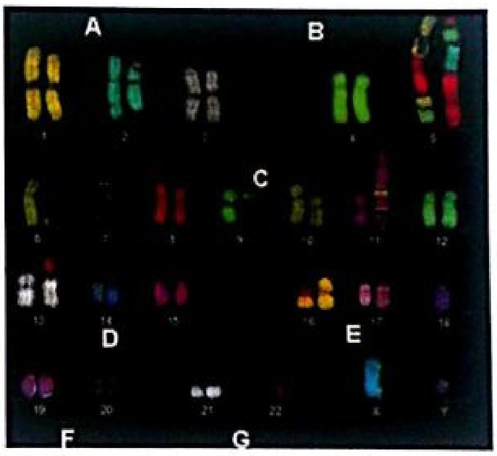
شفوي //

Normal chromosomes (normal karyotyping)

1. **Structure**
   - Two chromatids connected together at one point by centromere.
   - Each chromatid is composed of DNA in a framework of protein; each DNA is a double strand helix.
2. **Number**
   - Each somatic cell contains 46 chromosomes = diploid number (44 autosomes and 2 sex chromosomes), XX (female) or XY (male).
   - Each germ cell contains 23 chromosomes = haploid number, 22 autosomes and 1 sex chromosome X (ovum), X or Y (sperm).
3. **Size**
   - Autosomes are arranged into 7 groups (**A- B- C- D- E- F- G**) based on, their length, the position of the centromeres and banding pattern(staining techniques)

(فقط =)





Gene

1. **Structure**
   - It is the part of DNA that codes for the synthesis of a single polypeptide chain.
   - It is the molecular unit of heredity
2. **Number**
   - Each human has about 30,000 genes.
   - Two genes, one from the father and the other from the mother, determine every trait (feature or a character), except those on X chromosome.
   - If both genes are similar → homozygous, If they different → heterozygous
   - Hemizygous: males for genes on X chromosome as they have only one X.
3. **Types**
   - **Dominant gene**
     Express itself whether homozygous or heterozygous, the trait is determined by only one of the two genes.
   - **Recessive gene**
     Express itself, only when homozygous, the trait is determined by the presence of both genes

Edward's [illegible]
Patau [illegible]
TS.

Classification of genetic diseases

1. Chromosomal abnormalities(in the autosomes or in the sex chromosomes) numerical or structural
2. Single gene disorders (in the autosomes or in the sex chromosomes
3. Multifactorial inheritance
4. Mitochondrial inheritance

Discuss WR.

Chromosomal abnormalities (in the autosomes or in the sex chromosomes)

I. Numerical abnormalities

1. Autosomal abnormalities

لازم نميزة صورهم syndromes الـ

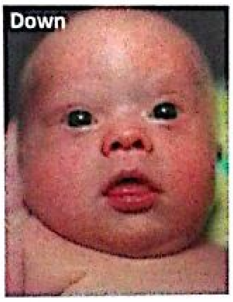
- Trisomy: extra chromosome is present e.g. trisomy 21: (Down syndrome), trisomy 18: (Edward's syndrome) and Trisomy 13 (Patau syndrome).
- Monosomies: one chromosome is missing: (monosomy: 21-22).

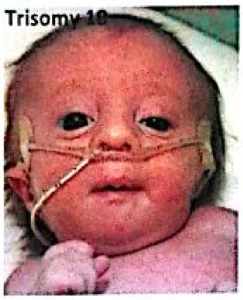
منفهمش يتقنوا علاقة كده ولا 3=

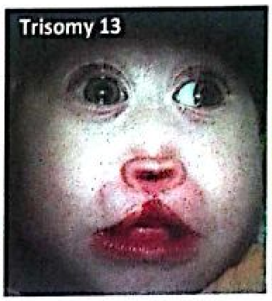
2. Sex chromosomal abnormalities

- Klinefilter syndrome (47,XXY male).
- Turner syndrome (45, XO female

• Super female → 47 (44+XXX)
→ Impaired mentality
⊕ Reproductive Problems.





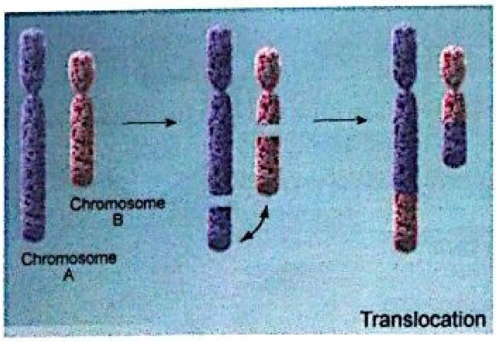


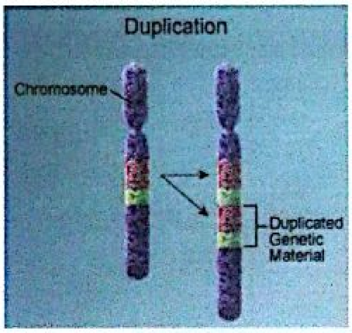
II. Structural abnormalities

1. **Translocation**: transfer of material from one chromosome to another
   - Reciprocal translocation: exchange of genetic material between 2 different chromosomes.
     - Balanced: the exchange involves no loss or gain of chromosomal material→ no effect
     - Unbalanced: results in unequal amount of chromosomal material→ dysmorphic features
   - Robertsonian translocation : the whole chromosome is translocated to another

     Example: translocation Down syndrome

Between non-homologous chromosomes





2. **Deletion**: loss of a portion of chromosome mostly through breakage.
   Example: loss of the tip of the short arm of chromosome 5 e.g. Cri du chat syndrome

• Deletion of a Part of chromosome 15 → [Prader-Willi Syndrome]
hypogonadism , hypotonia , obesity ←

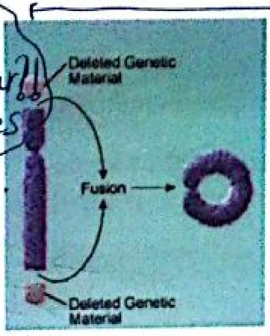
3. **Duplication**: the presence of an extra piece of a chromosome.

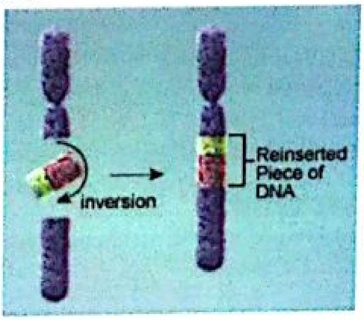
Special deletion

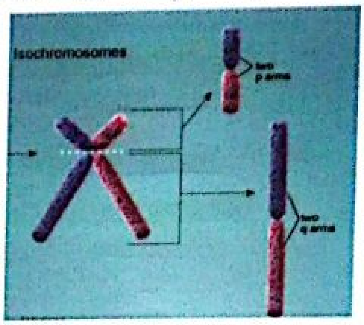
4. **Ring chromosome**: deletion in which both ends of the chromosome have been lost and the two broken ends have reunited to form a ring.
5. **Inversion**: fragmentation of chromosome followed by reconstruction but with segment inverted.
6. **Isochromosome**: during cell division, the centromere divides transversely instead of longitudinally.
7. **Chromosomal instability and breakage** e.g. fragile x chromosome (male with mental retardation and characteristic features)

ال Female ال X التاني معوض

* prominent Forehead
* Long Face
* Mandible ear?!
* large testes







Single gene alteration (in the autosomes or in the sex chromosomes)

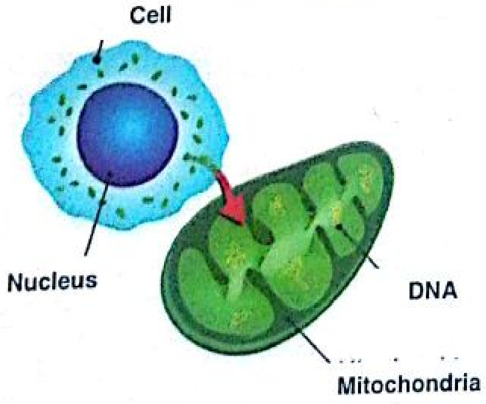
- Recessive: *2 copies* of the abnormal gene are present.
- Dominant: *one single copy* of the abnormal gene is present.

Multifactorial inheritance

- It is the inheritance that results from the interaction between genetic and environmental factors
- Examples e.g. congenital heart disease, pyloric stenosis, cleft palate.

Mitochondrial gene inheritance

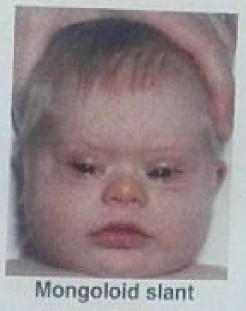
- It is inheritance through mitochondrial DNA (mitochondria contain small amount of DNA that code for enzymes important for mitochondrial functions).
- They are maternally inherited because the ova at fertilization supply them.
  e.g. mitochondrial encephalopathy and cardiomyopathy.

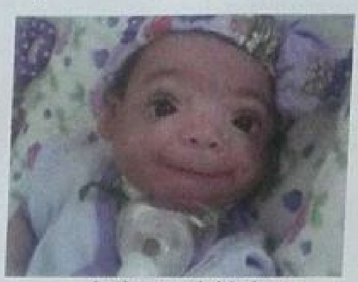


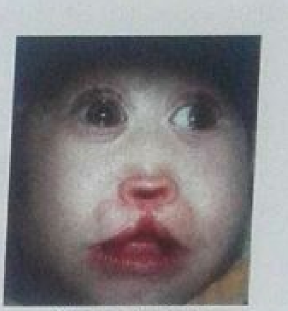
Malformation
Mental retardation
Ambiguous genitalia
Delayed Puberty

Clinical situations suspecting chromosomal abnormalities: karyotyping indications

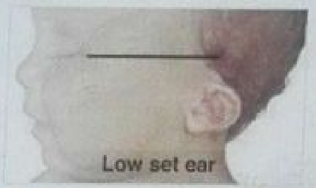
1. **Abnormal features** [Malformation]
   - **Face**: mongoloid features or coarse features.
   - **Eyes**: mongoloid or antimongoloid slant.


Mongoloid slant

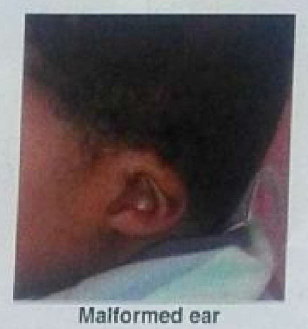

Antimongoloid slant

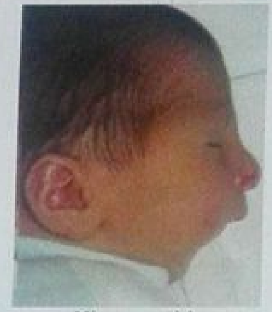

Coarse features

   - **Ears**: malformed or low set ears.
   - **Mouth and mandible**: cleft lip and palate, micrognathia (receding mandible).

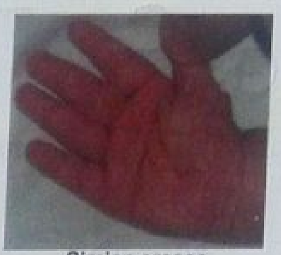

Low set ear

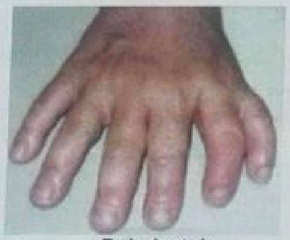
Normal ear

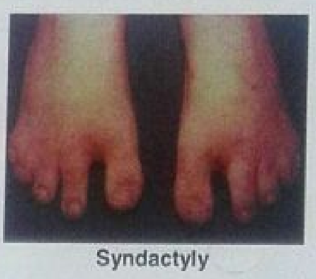

Malformed ear


Micrognathia

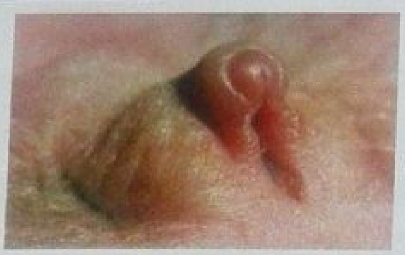
   - **Hands and feet:** simian crease (single palmer crease), polydactyly (extra finger), clinodactyly (incurved little finger), syndactyly (fused fingers), gap between first and second toe.


Simian crease

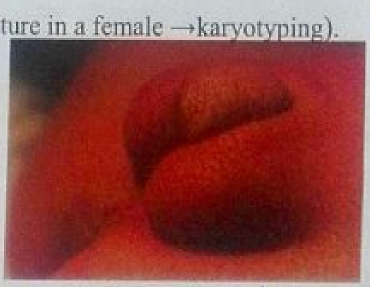

Polydactyly


Syndactyly

2. **Mental retardation**: all children with unexplained retardation.
3. **Ambiguous genitalia** (sex can't identified).
4. **Delayed puberty**: Klinefelter (males) and Turner (short stature in a female →karyotyping).



Ambiguous genitalia



5. Short stature in Females

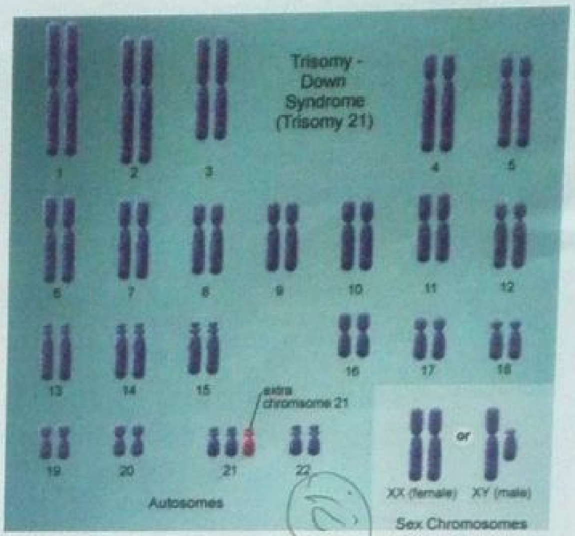
6. Spontaneous abortion
[7% ← Chromosomal abnormalities]

[illegible] Down Syndrome : Trisomy 21

Incidence 1:700, it is the commonest autosomal trisomy

Cytogenetic of Down syndrome

It is trisomy 21: the cell contain 3 Chromosomes number 21, instead of two (47 Chromosomes)



رضا لا سخط بعده أبداً في الدارين يا الله

1. Non disjunction	2. Translocation "Robertsonian translocation"	3. Mosaic
Incidence 95%	4%	1%
Mechanism . Non disjunction in maternal meiosis . The pair of chromosomes No: 21 fail to disjoin→ gamete with 24 chromosomes which when fertilized by normal gamete (23 chromosomes), it results in zygote with 47 chromosome in which 3 chromosomes are 21	The extra chromosome No:21 is not present separately but it is translocated to one of the chromosomes of : D group(13,14,15)commonly 14 or G group (21, 22) .The number of chromosomes in such *patient* will be only 46 chromosomes but one of them is abnormal (compound) →large abnormal	. Non disjunction in mitosis . Post fertilization . Occurs in early mitotic division→2 cell lines, one with 46 and the other with 47 chromosomes . Mild mental retardation and other features
Family history .Non familial	Familial	.Non familial
Age of mother Dependent	.Non dependent (young mother)	.Non dependent
Risk of recurrence Increases with advancing maternal age 1:2000 at the age of 20 years 1: 1000 at the age of 30 years 1: 100 at the age 40 years. 1:10 at the age of 50 years	.Translocation to D group(G/D) 1/3 Normal 1/3 Translocation carrier 1/3 Down .Translocation to G(21) :G/G 100 % 40% of G/D and 10% of G/G 21 are inherited	

كل ما تزيد في ال age كل ما احتمال إنها تجيب child down أكتر

Clinical picture

Motor and mental retardation

Delayed

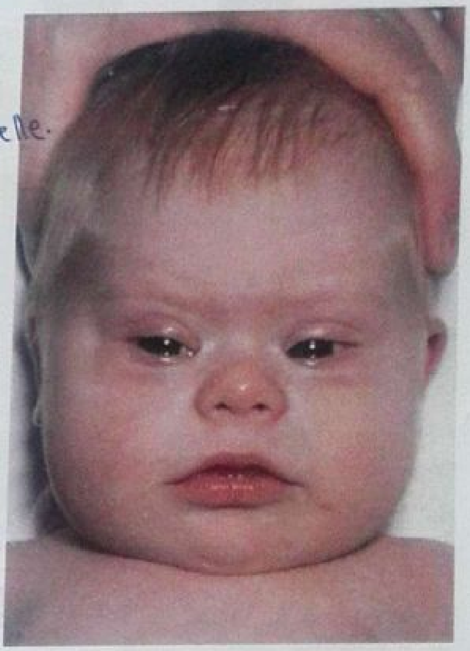
1. Delayed head support, sitting and standing (due to hypotonia).
2. Delayed smiling and recognition of mother.

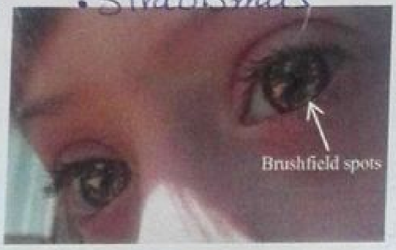
Physical growth retardation

1. Short stature for age.
2. Underweight for age.

Characteristic features: General and systems examination

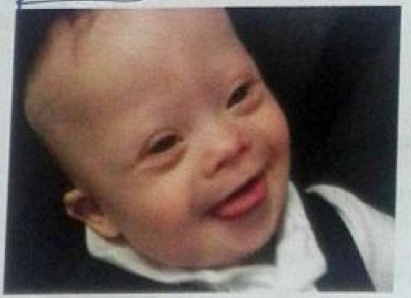
1. **Head**
   - **Skull**
     - Small head circumference
     - Brachycephalic: flat occiput
     - Delayed closure of ant. Fontanelle.
   - **Hair**: silky
   - **Eye**
     - Medial epicanthal folds
     - Lateral upward slope of eyelid
     - Brushfield spots (speckled iris) بقع بيضاء في ال Iris
     - Strabismus

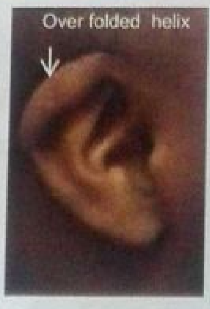


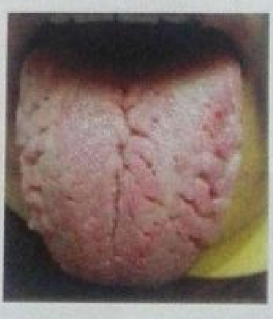


   - **Nose**: Short depressed nasal bridge.
   - **Ear**
     - Small external ear with over folded helix.
     - Underdeveloped lobule.
   - **Mouth**
     - Small oral cavity (hypoplastic mandible).
     - Tongue: protruded and fissured "Scrotal tongue"

dt. small mandible



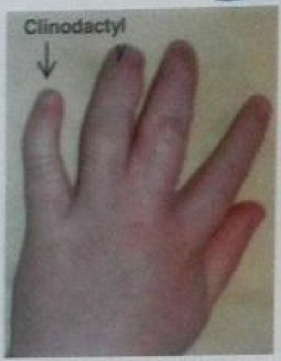


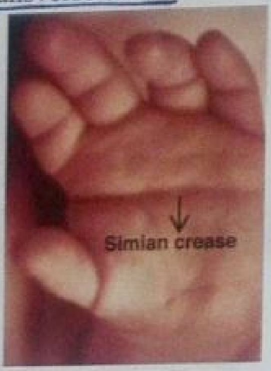


2. **Neck** : Short and broad
3. **Limbs**

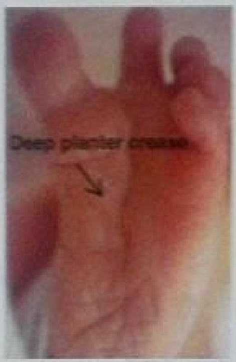
- **Hands**
  - Short and broad
  - May bes. Clinodactyly incurving of the 5th finger
  - Simian crease joined 2 palmer transverse creases into one transverse crease

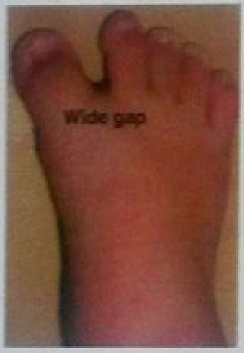
Normal Finding in normal Personals

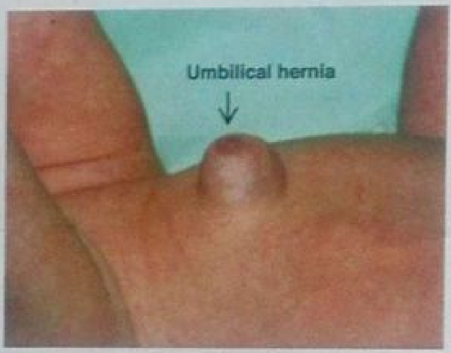




- **Feet**
  - Short and broad < Sole toes
  - Wide gap between the first and second toe



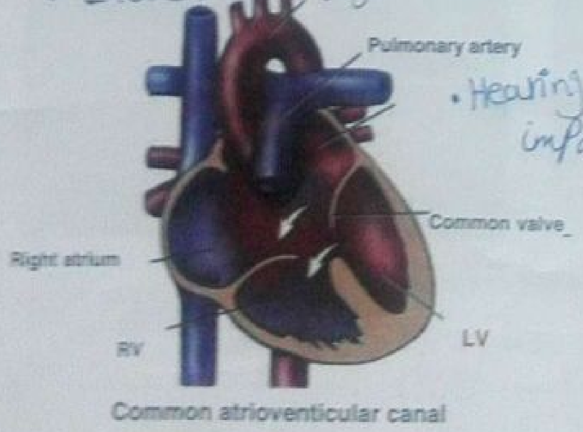




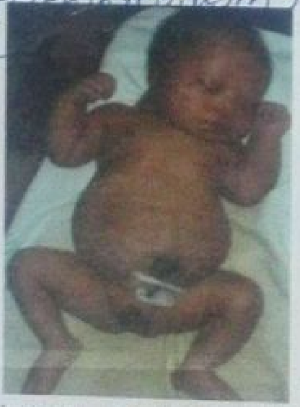
4. **Trunk**
   - Genitalia: small penis and may be undescended testes.
   - Hernia
   - Broad iliac Bones / Abdominal distension
5. **Systems**
   - **Heart**: cardiac anomalies (40 % of cases): endocardial cushion defect VSD, ASD, common atrioventricular canal, PDA and Fallot tetralogy.
   - **Chest**: Recurrent chest infection
   - **CNS:** Generalized hypotonia (more evident in neonates), laxity of ligaments "Acrobatic maneuver" Epilepsy
   - **GIT**: duodenal atresia (present in neonatal period with bile- stained vomitus) and anal atresia [Imperforate anus] – Hirsh Sprung disease (Megalocolon)
   - **Renal anomalies**
   - Endocrinal → High incidence of (DM - Hypothyrodism)

Congenital Anomalies

- Hearing and Visual impairment



Common atrioventricular canal



Hypotonia → Frog like leg position
Abdominal distention

Complications

1. Higher susceptibility to infections especially recurrent respiratory tract infections.
2. Heart failure in cases with congenital heart disease.
3. Higher incidence of leukemia: in 1% of cases
4. Hypothyroidism and diabetes mellitus.
5. Hearing problems (secretory otitis media) and visual problems (cataract)
6. Alzheimer's disease and Epilepsy and
7. Accidents are one of the most important causes of death in Down' syndrome

Investigations

Laboratory

1. Karyotyping to determine the genetic type of Down syndrome and risk of recurrence.
2. Complete blood count, if leukemia is suspected.
3. Thyroid profile and regular blood glucose checking.

Imaging

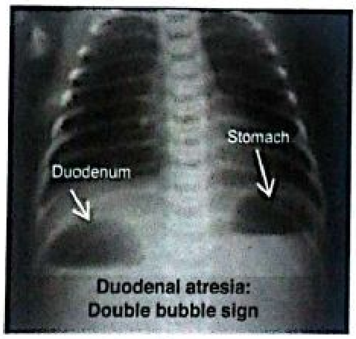
الحزن يوهن القلب ويضعف الإرادة ويضر العزيمة!
لا بأس!

1. Plain X ray
   - Chest for pneumonia.
   - Abdomen to exclude GIT anomalies (in neonates e.g. duodenal atresia).
2. Echocardiography: to exclude cardiac anomalies.
3. Abdominal ultrasonography: to exclude renal and gastrointestinal anomalies

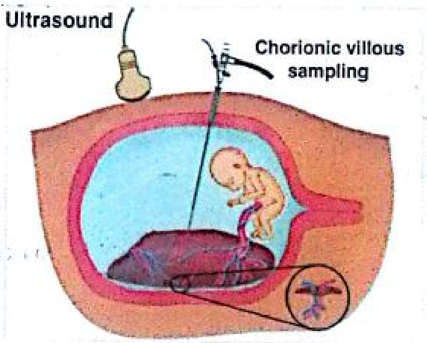
Regular hearing and vision testing

Prenatal diagnosis of Down syndrome

1. Triple test (↓↓ α fetoprotein – ↓↓ estradiol – ↑↑ human chorionic gonadotropin)
2. Ultrasonography : thickening of the fat pad at the back of the neck
   → if the risk is high amniocentesis is done.
3. Amniocentesis: low of α fetoprotein. - obtain cells for karyotyping.
4. Chorionic villous sampling for karyotyping.



Duodenal atresia:
Double bubble sign



Treatment: rehabilitation and management of complications

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النقط دي

1. Diagnosis and management of complications and associated anomalies: e.g. heart failure and chest infections.
2. General measures: special schools for rehabilitation and education.
3. Specific measures: speech therapy and physiotherapy.

Educational and
Social
↳ See Neurology

Prognosis

- In absence of congenital heart disease, long-term survival is usual (in other trisomies 90% of babies died in infancy.
- Children with Down syndrome are usually happy and love music

⊛ Decreased Fertility and libido but a female down may have a Chil
(50%) down.

Sex Chromosomal Abnormalities

Turner syndrome (Gonadal dysgenesis)

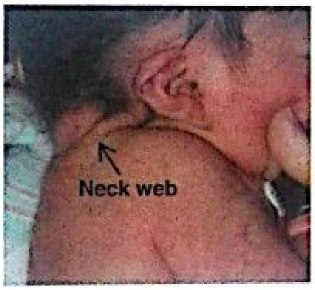
[illegible]

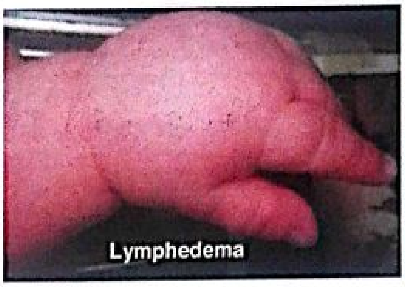
Incidence: 1: 5000

Genotype 45X0 44 + X

Clinical picture female

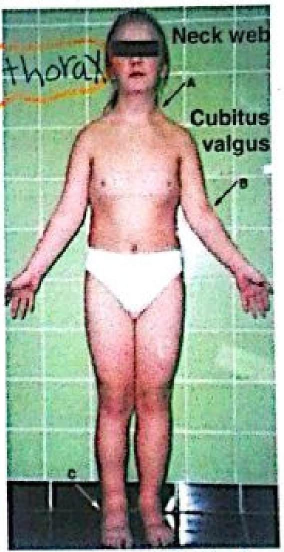
- **Neonatal period**
  1. One third of cases diagnose during neonatal period with webbing of the neck.
  2. Lymphedema of the hands and feet.

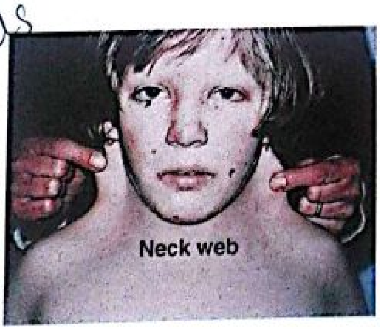


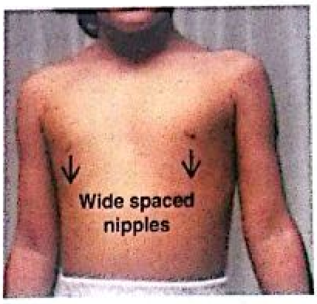


- **Childhood period**
  1. Short stature is the most common presenting feature.
  2. Head: low posterior hairline.
  3. Neck: webbing of the neck.
  4. Chest: broad chest and wide spaced nipples.
  5. Limbs: cubitus valgus (wide carrying angle). Short 4th metacarpal
  6. Cardiac anomalies: coarctation of the aorta in 20% of cases.

Shield-shaped thorax







* Small Fingernails

* Nevi

- **Adolescence**
  1. Failure of development of secondary sexual characters.
  2. Primary amenorrhea (the ovary is a streak of connective tissue).
  3. Normal mentality but there may be some learning disability.

* Hearing defect

* AI-thyroiditis → Auto-immune

* Constriction of Aorta

* Poor Breast development

* Renal anomalies

* Infantile uterus

Investigations

- **Laboratory**
  1. Karyotyping: 45 XO
  2. Hormonal study (gonadal failure); decreased estrogen and increased FSH and LH
  3. Thyroid function tests (more prone to hypothyroidism).

- **Imaging**
  1. X ray to determine bone age
  2. Echocardiography: may be aortic coarctation
  3. Abdominopelvic ultrasound: may be renal anomalies (40% of cases), uterine anomalies, ovaries (streaks of connective tissues)

Treatment: → till puberty

1. Growth hormone therapy and estrogen → then Cyclic estrogen and progesteron → كل 21 يوم For 2ry sexual characters only.
2. Management of any associated conditions e.g. aortic coarctation, hypothyroidism

Klinefelter syndrome

Incidence: 1: 1000

Genotype ⓸⓻XXY (extra X) 44 + XXY

Clinical picture male

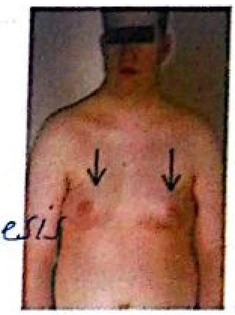
1. Tall Stature.
2. Gynecomastia
3. Small testes- (azoospermia) — معندوش Semi-nephrous tubules
4. Absence of Secondary sexual characters.
5. Infertility: the most common presentation
6. Intelligence usually in the normal range but may have educational and psychological problems. Mild mental Retardat — low Testosteron

Investigations

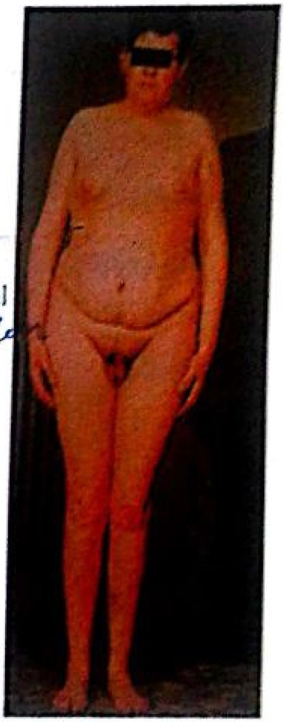
1. Karyotyping: 47 XXY
2. Hormonal study: increased FSH and LH
3. Gonadal Biobsy: dysgenesis

Treatment:

Testosterone at time of puberty



Gynecomastia



- Klinefelter syndrome manifestations usually don't appear before puberty
- Klinefelter syndrome is not a serious disease, apart from infertility, most affected males lead normal lives

prognosis

اجبني!

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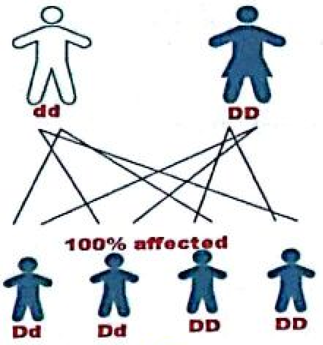
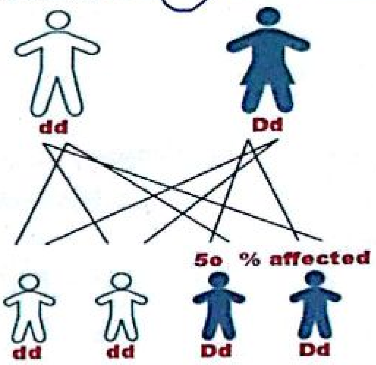
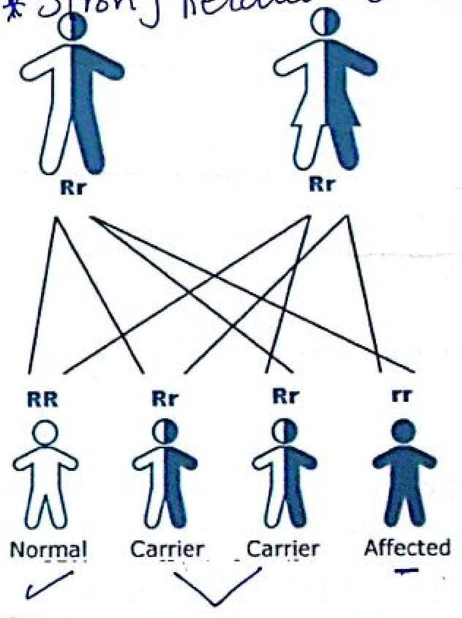
Single Gene Disorders

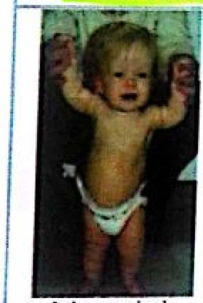
Discuss

Autosomal inheritance

Autosomal dominant	Autosomal recessive
Definition Gene mutation that is:- located on the autosomes, and express itself whether homozygous or heterozygous	Gene mutation that is:- located on the autosomes, and express itself only when homozygous
Characters 1. **Affected person** · May be homozygous or heterozygous · Has an affected parent at least · If heterozygous: 50 % of his children are affected · If homozygous : 100% are affected · Associated usually with structural abnormalities **Homozygous: 100% affected**  **Heterozygous: 50% affected** 	1. **Affected person** → one from each parent · Must be homozygous(has 2 affected genes) . Both parents have at least one affected gene . 25 % of sibs (of-springs) are affected on the average . Associated usually with defective enzyme activity. * Equal distribution (Males, females) * Strong Relation to Consanguinity  Rr Rr RR Rr Rr rr Normal Carrier Carrier Affected **25% are affected on the average**
2. **Unaffected person** → Completely healthy . Has no affected gene and do not transmit the trait to his children.	2. **Unaffected person** (phenotypically) . May have an affected gene (carrier)and can transmit the trait.

No Carrier State

Most of humans Carry at least one autosomal recessive gene and so, Married relatives may carry the same abnormal gene

3. Transmission Not affected by sex or consanguinity . Expressivity Marked variation in the degree of severity.e.g. Patients with neurofibromatosis may show only café au lait patches, while others are severely affected.	**3. Transmission** · Not affected by sex but parents may be consanguineous (related parents are much more likely to have the same abnormal gene because they have a common ancestor) ⊛ · High incidence in certain groups e.g. B Thalassemia in Mediterranean races . Carriers of some autosomal recessive disorders may be biologically fitter than non- carriers e.g. sickle cell disease carriers are relatively immune to malaria while carries of cystic fibrosis are immune to salmonella infection. ..سبحان الرحيم!
Examples 1. Skeletal · Osteogensis imperfecta. · Achondroplasia •otosclerosis · Marfan syndrome. •Ehler Danlos S. 2. Hematological C. spherocytosis · Hereditary spherocytosis •Von Willebrand disease• 3. Renal: Polycystic kidney(adult type) 4. Neurological · Neurofiromatosis •Myotonic dystrophy · Tuberous sclerosis •Huntington's disease ♦ Over 3000 disorders have been identified	**Examples** 1. Metabolic · Galactosemia. •Cystic Fibrosis · Phenylketonuria •Glycogen storage disease · α 1 antitrypsin deficiency 2. Hematological · Thalassemia, sickle cell anemia 3. Endocrinal: Adrenogenital syndrome – goitrous Cretinism Neurological Werding Hoffman disease ♦ Over 1500 disorders have been identified
 Achonroplasia Neurofibromatosis	 Thalassemia Werding Hoffman disease

eg Examples

Sex linked inheritance

لازم نتكلم عن
ال X الأول
وبعدين ال Y
[illegible]

1. **Gene on Y chromosome**

Holanderic inheritance

- Passed in the male line exclusively-the trait appears only in males
- Example: hairy pinna.

2. **Gene on X chromosome**

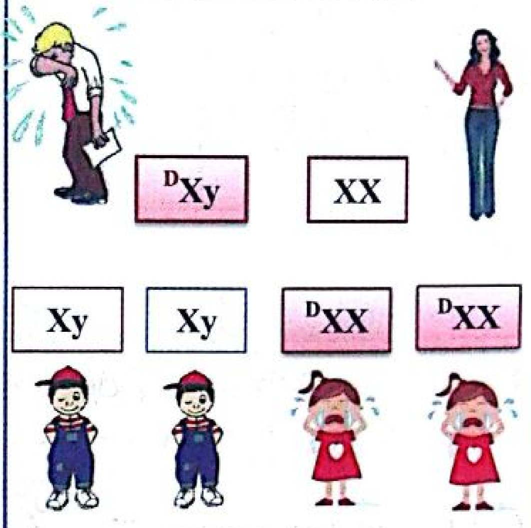
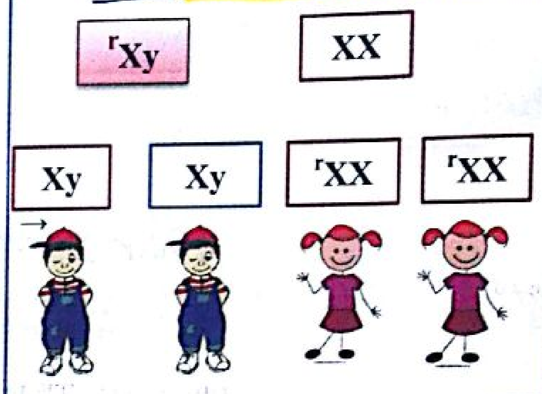
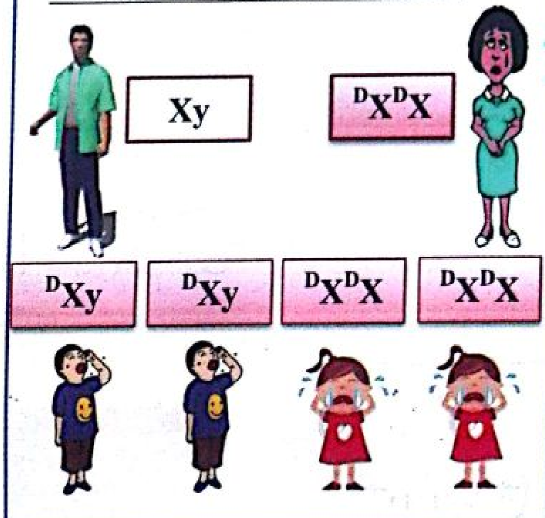
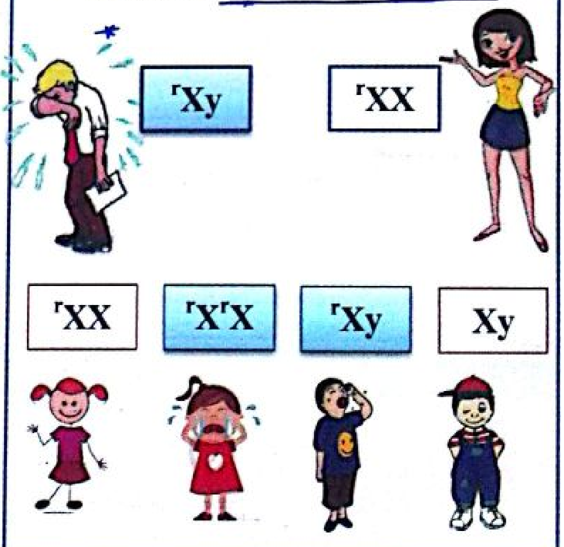
- **Males :** hemizygous
- **Females:** homo or heterozygous

Hi, عملية تعرف ?!

فتحي خالد
لا صعوبة
١٧٢
هجيبك يعني
ماتقلقش

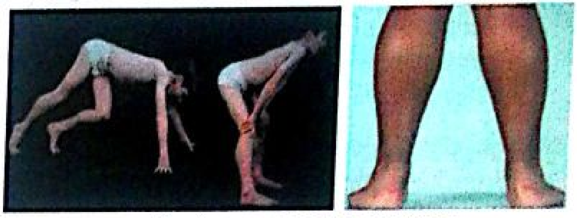
كنت هقول ماتقلقش، بس هتقلق - أوي لالالا

مش فاضية للأسف =P

X linked dominant	X linked recessive
Characters **1. Affected male** - All sons are free. - All daughters are affected.	**1. Affected male** - All sons are free - All daughters are carriers. Carrier female will transmit the disease to half of her sons who will be diseased and half of her daughters who will be carriers (vertical or Knight move inheritance)
	
2. Affected female - If heterozygous: 50% of children are affected regardless the sex. - If homozygous: 100% of children are affected regardless the sex. The same as in autosomal dominant	**2. Affected female** *lyonization ?! - Homozygous : when she has a carrier mother and diseased father - Heterozygous :Female (turner) X0 - In general, less affected than males.
 Xy $^{D}X^{D}X$ ^{D}Xy ^{D}Xy $^{D}X^{D}X$ $^{D}X^{D}X$	 ^{r}Xy ^{r}XX ^{r}XX $^{r}X^{r}X$ ^{r}Xy Xy
Examples - Vitamin D resistant hypophosphatemic Rickets - Pseudohypoparathyroidism.	**Examples** - Aagammaglobulinaemia - Blood disease : Hemophilia and G6PD deficiency - Color blindness - Duchenne muscular dystrophy - Lesch-Nyhan syndrome.

DNA analysis: early diagnosis of single gene disorders by DNA analysis

1. **Prenatal (fetal diagnosis)**
   Early diagnosis of serious diseases giving a chance for early abortion e.g.
   - B thalassemia.
   - Cystic fibrosis
   - Duchenne muscular dystrophy
2. **Pre symptomatic diagnosis**
   In autosomal dominant disorders
   - Myotonic dystrophy
   - Huntington's disease


Duchenne muscular dystropy

3. **Carrier detection**
   - In x linked inheritance e.g. Duchenne dystrophy or Hemophilia.
   - In autosomal recessive disorders as cystic fibrosis
4. **Confirmation of a clinical diagnosis**

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Multifactorial (Polygenic) Inheritance

Definition

many genes

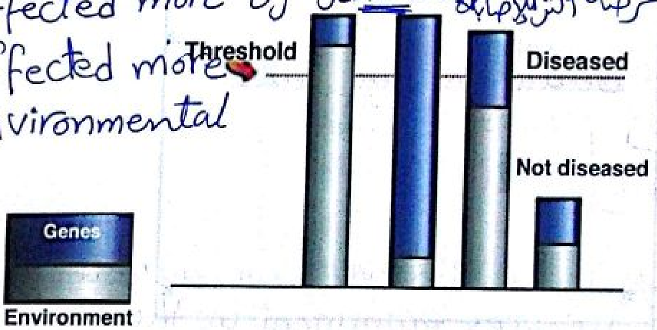
It is the pattern of inheritance that results from the interaction between genetic and environmental factors.

Characteristic features

1. **More common** than single gene disorders but with much lower recurrence risk (2-5%).
2. **Polygenic**
   - Several genes are involved in the expression of the trait (polygenic).
   - There are no dominant or recessive genes, but every gene is sharing in the phenotype → The susceptibility is determined by the additive effects of all genes
3. **Multifactorial**
   - Environments interact to mask or unmask the effects of genes.
   - There is threshold value needed to develop a disease, this value is determined by Both genetic and environmental factors.
4. **The risk of recurrence of the disease**
   - The same among all first-degree relatives of the affected child.
   - Decreases as the relationship with the affected child becomes more distant.
   - Increases with increased number of affected members in the family (or) affected Person is of the less risky sex

Females affected more by genetic → يعني الأطفال عرضة أكثر للإصابة

Males affected more by Environmental

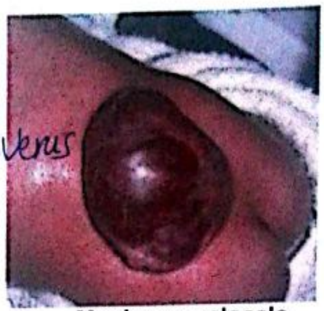


Examples

1. **Congenital malformations/disorders of infancy**

Intra-uterine Environment الرحم

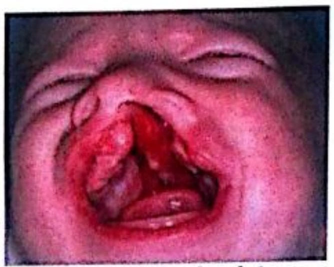
- Pyloric stenosis
- Neural tube defects
- Cleft lip or palate
- Congenital heart disease
- Congenital dislocation of the hip
- Hypospadius
- talipus equinoverus


Meningomyelocele

2. **Acquired disorders of childhood**

Genetic

- Bronchial asthma
- Diabetes
- Epilepsy
- Hypertension


Cleft lip and palate

3. Acquired disorders of adult:-

- DM (Type I, II)
- Alzheimer's
- Hypertension
- Atherosclerosis and Coronary heart disease.

4. Normal criteria:- Height - Intelligence.

WR Btc

Genetic counseling

Definition

The process of providing information about inherited disorders in the family and how to avoid it.(by prenatal diagnosis and carrier detection)

Goals of genetic counseling

1. Establishing the correct diagnosis of the genetic disease by detailed history, examination and investigations.
2. Estimating the risk of recurrence (the possibility of getting another affected baby)
   - **Chromosomal disorders: 1% (very low) : remember recurrence risk in Down syndrome**
   - **Multifactorial inheritance: 2-5%**
   - **Single gene inheritance: 25-50%**
   - × This requires both diagnostic and pedigree information.
3. Communication with family.
4. Discussing options for management and prevention.

Discuss

لازم تشرحة عن اخواتها =3

Indications:-

1. Mention indication of Karyotyping
2. Microcephaly / Macrocephaly / Very Short / very tal بالنسبة لأطوال أهلهم وأعمارهم
3. Bleeding disorders tendency
4. Metabolic disorders
5. Consanguinous marriage indicate screeing for autosomal recessive diseases based on diseases prominent in the Population (SCA in black Africans / thalassemia in mediterranean area

Nutritional Requirements

1. Water requirement

Infancy	2-6 years	7-12 years	13-18 years	Adults
120 ml/kg/day	100	90-80	80-70	50-40

2. Calories

- **Required amount (Kcal/kg/day) according to age**:-

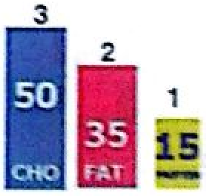
0- 6 months	6-12 months	1-3 years	4-6 years	7-10 years
115	95	95	90	75

Rapid growth rate and energy requirement during the first year of life

- **Required for**

Basal metabolism : 50 % of caloric intake		Physical activity: 25%
Growth : 12%	Fecal loss : 8%	Specific dynamic action:5%

- **Required ideal distribution**
  - Carbohydrate`s should supply 50% of total caloric intake
  - Lipids: 35%
  - Proteins: 15%



3. Protein

- **Required amount (Kcal/kg/day) according to age**

0- 6 months	6-12 months	1-3 years	4-6 years	7-10 years
2.2	2	1.8	1.5	1.2

Proteins needs are higher in infancy and childhood due to rapid rate of growth.
Proteins are high biological value (animal proteins) and low biological value (plant protein).

- **Required for**
  - Formation of cells and cellular elements: growth and development
  - Formation of enzyme, hormones and other vital blood proteins e.g. hemoglobin

4. Carbohydrates: supplies 50% of energy requirement: 10 gm/kg/day. (1% of body weight)

5. Lipids: Supply the rest of caloric intake not supplied by protein and carbohydrates

6. Minerals and vitamins

Iron	A	D	B1:Thiamine	B2:Riboflavine	C
10-15 mg/d	2000IU	400 IU	1mg	1mg	50

7. Fibers e.g. fruits, vegetables bulking effect and prevent constipation

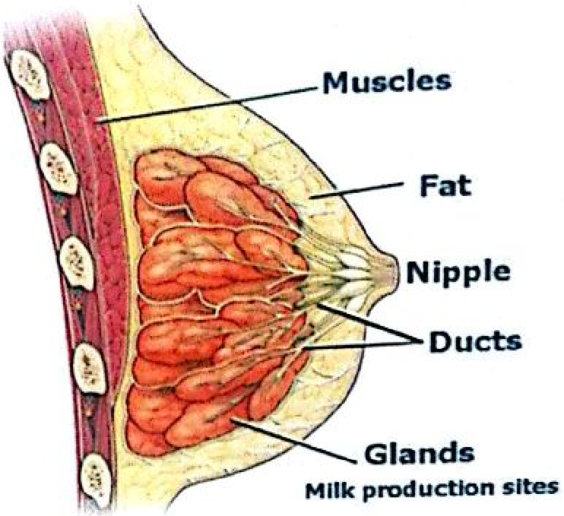
Breast Feeding

Physiology of lactation

- **Hormonal control of mammary gland development and lactation**

Prolactin (anterior pituitary)
- Stimulates milk production in the breast
- Breast evacuation is the main stimulus for milk production.

Oxytocin (posterior pituitary)
- Stimulates ejection of milk from the breast
- Suckling is the main stimulus for of oxytocin release



- **Let down reflex**
  - It is the release of milk from the breast in response to oxytocin.
  - The reflex is stimulated by:-
    Suckling (the major stimulus).
    Others: thinking of the baby- hearing the baby cry.
  - The reflex is inhibited by
    Anxiety
    Stress
    Fatigue.

Factors that maintain milk flow

1. **Mechanical factors**
   - Suckling and complete emptying of the breast are the most important factors
2. **Nutritional factors**
   - Adequate diet
   - High: protein, vitamins and fluids. **Avoid:** coffee, smoking onions, spices and chocolates

3. **Psychological factors**
   - Relaxation, confidence and happiness are very important factors.

Advantages of breast feeding for infant and mother

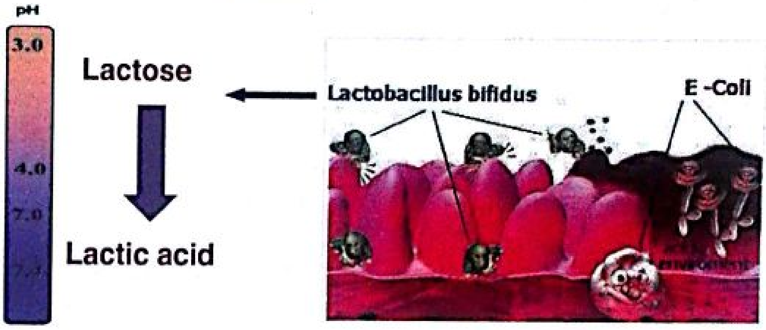
- **Advantages for the Infant**

Nutritional advantages

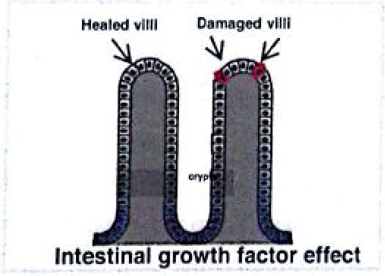
1. Composition of various nutrients is in proportions ideal for the infant's needs
2. Examples : fat quality- protein quality- calcium phosphorus ratio) discuss table P 73

Immunological advantages: protective mechanisms in human milk.

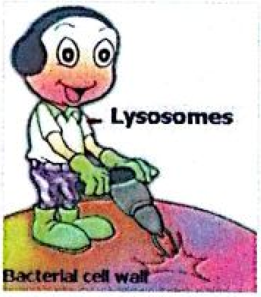
1. **Bifidus factor** (oligosaccharides) present in both colostrum and mature milk, favors the growth of lactobacillus bifidus which is an intestinal flora responsible for acid production →acidic environment that inhibits growth of bacteria e.g. E-coli→ breast fed infants are less liable to diarrhea.



2. **Intestinal growth factor** that stimulates the repair of damaged intestinal cells.
3. **Immunoglobulins** in colostrum and mature breast milk: (especially secretory IgA that provide mucosal protection) → protect against respiratory tract infections.
4. **Lysosyme**: an enzyme that attack bacterial cell wall.



Intestinal growth factor effect



5. **Lymphocytes**, macrophages and polymorphs: have a role in phagocytosis and cytokine production.
6. **Lactofererrin**: fe binding protein enhances the bioavailability of iron from human milk, reducing its availability for bacteria.
7. **Low** incidence of **allergic** disorders and low incidence of insulin dependent diabetes mellitus, hypertension and obesity.

2 factors	**1**	**4 L**
. Bifidus	Immunoglobulin	. Lysosomes- Lymphocytes
.Intestinal growth		. Lactoferrin - Less allergic

General advantages

1. Sterile, cheap, always available and needs no preparation.
2. Provides good maternal child relationship→emotionally stable child and mother.
3. Stimulates psychomotor and social development, through frequent skin to skin contact and interaction with the mother.

Advantages for the mother

- Natural contraception (not reliable) increases the time interval between children.
- Decrease risk of breast cancer.

Skin to skin contact

Interaction

I am sad, I am not breast fed

Stages of lactations (Composition of breast milk : colostrum – transitional - mature)

1. Colostrum

	Colostrum	Mature breast milk
Timing	First 3 days	After 2 weeks
Color	Yellowish(beta carotene content)	White
Consistency	Thick	Thin
Amount	40 -60 ml/day	1-2 litre/day
pH	Alkaline(higher)	Acidic
Specific gravity	1040-1060(higher)	1020- 1040
Protein content	8 gram%(higher)	1.3 gram%
Carbohydrate	5.5 gram%(lower)	6.7 gram%
Fat	3 gram%(lower)	3.6 gram%
Minerals	4 gram%(higher)	0.25 gram%

2. Transitional milk

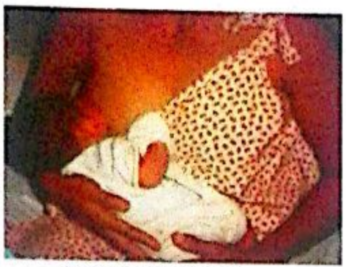
- Its production begins 5-7 days postpartum) and continues for 2-3 weeks.
- Composition is midway between colostrum and mature milk

Mature Breast milk	Cow milk
1. Calories 67 Kcal / 100 cc milk	The same
2. Carbohydrates ▪ **Quantity** 7gm%	4 gm%
▪ **Quality** · Lactose is the main carbohydrate · Oligosaccharides: present (bifidus factor?)	· Lactose is the main carbohydrate · No oligosaccharides
3. Fat ▪ **Quantity** 3.5 gm%	4.5 gm%
▪ **Quality** · Volatile fatty acids (irritant) Lower concentration→less irritant GIT	· Higher →more GIT irritation
· Long chain polyunsaturated fatty acids Which essential for brain development) are present in higher concentration	· Insufficient for optimal neurological development
· Triglycerides are the major source of energy in human milk (50% of calories)	
4. Protein ▪ **Quantity** 1.2 gm%	3.5 gm% (load on the infant's kidney)
▪ **Quality** · Whey to casein ratio is 60: 40 → easier digestion(whey is soluble protein)	· Ratio is 37:63 Difficult digestion→ gastric upsets
· Lactoferrin helps iron absorption and protects infant from bacteria.	· No lactoferrin (iron is less absorbed)
· Immunoglobulin: secretory IgA. · Digestive enzymes(lipase, amylase, protease) are present that help digestion · Hormones and growth factors are present	· Milk protein is potent allergen, should not be given before 1 year in infant with positive family history of insulin dependent diabetes.
5. Minerals · Less phosphorus and calcium, but their ratio is 1.5/1, optimal for proper absorption. · Fe and zinc are more bioavailable: better absorption.	· Calcium phosphorus ratio4/3 which is not optimal for absorption · Fe and zinc are less bioavailable
Less sodium	· Higher sodium
6. Vitamins · A and B complex are adequate · C and D are inadequate	. Inadequate and less absorbed
7. Water **87.5%:** sufficient to meet the needs	The same

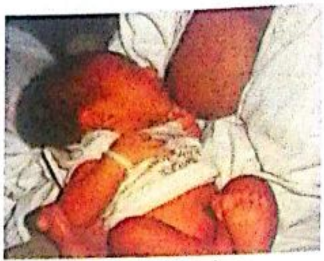
Technique of breast feeding

- **Positioning**

1. The infant should be elevated to the height of the breast.
2. The infant's body: turned completely to face the mother. All the body should be supported not just the neck.
3. The infant's neck is straight.



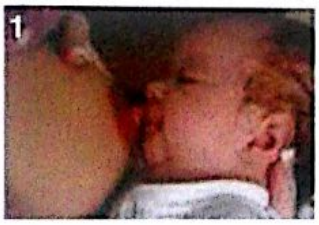
Proper positioning

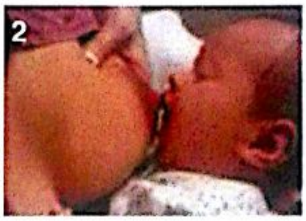


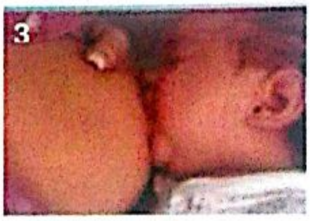
Poor positioning

- **Attachment to the breast**

1. The mother touches her infant's lips with her nipple.
2. The mother Waits until her infant's mouth is wide open, then
3. Moves her infant quickly to her breast, with the lower lip below the nipple.

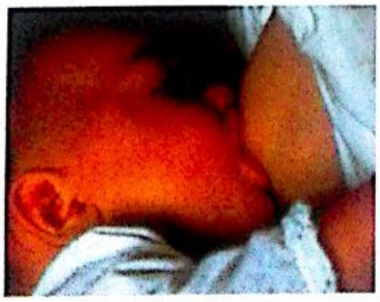




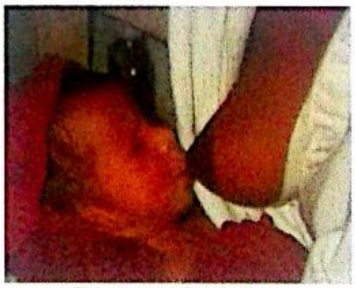


Signs of good attachment

1. More areola is visible above than below the mouth.
2. Mouth: wide open - lower lip turned outwards.
3. Lower lib turned outward.
4. Chin very close to or touching the breast.



Good attachment



Poor attachment

Signs of effective suckling

1. Sucks are slow and deep
2. Swallowing can be seen or even heard

How to ensure successful breast feeding for healthy newborn ?

1. **Early skin to skin contact immediately after delivery**

The baby is put naked on the mother's chest, between her breasts, this practice:

- Worms the baby by mother's body
- Increases prolactin release
- Decreases neonatal distress

2. **Early breast feeding, if possible within the first hour after birth**

- Improves breast feeding outcome
- Insures taking Colostrum which is adequate for the baby

Skin to skin contact

Early breast feeding

3. **Avoid giving the newborn baby glucose after delivery, unless medically indicated** e.g. hypoglycemia.

- Glucose is nutritionally deficient.
- Some babies refuse breast milk after glucose.

4. **Avoid use of pacifiers as it can slow down the weight gain**

- It satisfies the baby's hunger, thus decreasing the demand on the breast.
- It trains the baby to attach poorly on the breast with closed mouth, thus milk withdrawal is affected.
- It predispose to oral fungal infections and thus pain.

5. **Avoid bottle feeding as it leads to nipple confusion**

Rooming in

Avoid pacifiers, bottles and glucose

6. **Rooming in: the baby stays on mother's room or better co-bedding (stays beside his mother in bed)**.

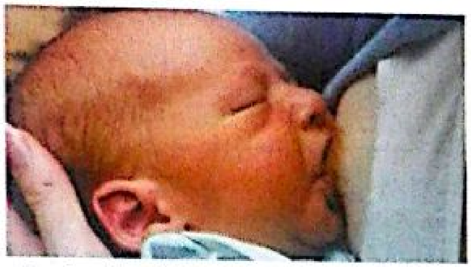
- It decreases neonatal distress.
- Allows for more frequent breast feeding.
- Stimulates prolactin release,

7. **On demand feeding with no restriction to time, frequency or duration**
   - The more the baby withdraws milk from the breast, the more the prolactin is formed and the more milk is produced.

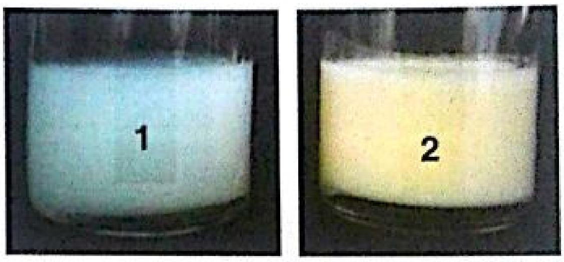
8. **Exclusive breast feeding without supplements during the first 6 months of life**
   - Any supplements given the baby will decrease the demand on the breast and the supply will decrease
   - Even twins can depend on the breast milk exclusively as when they withdraw double the amounts of milk, this signals the breast to produce extra supply.
   - Breast feeding can be continued for one year or more provided that weaning is started properly at the age 6 months.

9. **Ensure perfect positioning of the baby and attachment on the breast**

10. **Empting the breast before shifting to the other because milk** at the end of the feed contains good fat essential for brain and body growth



Perfect positioning and attachment



Foremilk at the feed beginning: High water low fat (1)
Hind milk at the feed end: Low water high fat (2)

How to ensure successful breast feeding for the sick newborn ?

1. **Frequent milk expression** :every 3 hours , otherwise the milk will dry gradually

2. **Kangaroo mother care strategy**
   - Whenever the baby starts to be stable, he is put skin to skin on the mother's chest inside her clothes.
   - This stabilizes the baby's vital signs,
     - Improve growth
     - Improve breast feeding

3. **Avoid bottle feeding**, if direct breast feeding is not applicable , the baby should be fed by nasogastric tube, cup, dropper or syringe to avoid nipple confusion when the baby is put on the breast after bottle feeding

Factors that decrease breast milk production

1. Mother and baby separation.
2. Feeding babies in the nursery at night.
3. Scheduled feeding (feeding at fixed times).
4. Bottle supplementation.

Indicators of adequate breast milk intake

Infant

1. **Weight gain**: the most reliable: 200 gram/week or 250 gram /10 days (in the first 4 months)

2. **Feeding**
   - Baby feeds at least 8 times / day.
   - Baby makes swallowing noises throughout the feeding.
   - Baby is satisfied and sleeps after feeds for 2- 4 hours.
3. **Urine**: baby wets 6 or more diapers/day.
4. **Stool**: 4 or more motions /day (soft yellow stools commonly with every feed).

Mother

1. Marked filling of breast before feeds.
2. Let down sensation: - milk flow from one breast while nursing from the other breast.

Drugs secreted in breast milk

Group	Safe drugs	Contraindicated
1. Antibiotics	Penicillins-Cephlosporins Erythromycin	Chloramphenicol Tetracycline
2. Analgesics and antipyretics	Aspirin, Paracetamol and ibuprofen	Indomethacin Ergot
3. Hormones	Insulin and small dose steroids	Estrogen
4. Vitamins	B , C	A and D in large doses
5. Sedatives and antihistaminics	In small dose	In large dose
6. Other contraindicated drugs : anticoagulants, antimetabolites and metronidazole		

Minor problems with breast feeding

1. Nipple soreness

- **Causes** : improper attachment to nipple

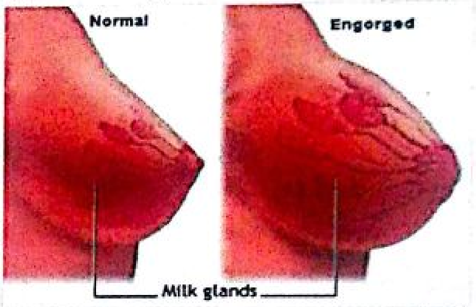
Nipple soreness

Breast pumping

- **Management**
  - Proper positioning and attachment.
  - Begin Nursing on less affected side
  - Nursing for shorter periods.
  - After Nursing: allow air drying of the nipples and apply Lanolin cream.
  - Pumping in severe cases

2. Breast engorgement

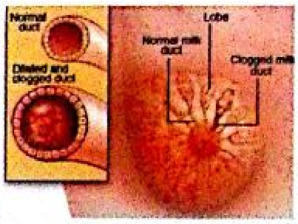
- **Causes**: incomplete breast evacuation due to:
  - Maternal illness e.g. sore nipples
  - Infant illness → weak suckling and infrequent feeding



- **Management**
  - Proper and frequent breast evacuation (starting from day 4: onset of excessive milk secretion) . breast engorgement is common between 2-6 days postpartum.)
  - Treatment of sore nipples.
  - Breast pump may be needed

3. Insufficient breast milk

- **Diet**: adequate diet and fluid to the mother
- **Breast measures**
  - Massage breast before and during feeding
  - Hot towels to the breast 3-5 minutes before feeding.



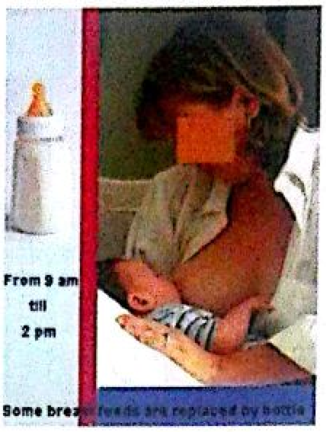
4. Breast feeding jaundice : discuss form neonatology: P 314

Formula Feeding

Indications

Breast feeds are completed by bottle feeds

Complementary


From 9 am
till
2 pm
Some breast feeds are replaced by bottle

Supplementary

All breast feeds are replaced by bottles

Substitutive

1. Complementary feeding (breast feeds are *completed by* bottle feeds)

- When breast milk is not enough (scanty breast milk secretion).
- Precautions
  - Be sure first that the mother's milk is not adequate (by assessing the rate baby weight gain).
  - Breast milk should be given first, and then the feed is completed by bottle.
  - The prescribed milk should be one of the humanized milk formulas.

2. Supplementary feeding (*some* breast feeds are *replaced by* bottle feeds)

- Working mother: one or more feeds are given during the period of mother absence.
- Twin delivery (if breast milk is not enough): breast and bottle are given to each baby alternatively.

3. Substitutive feeding (*all* breast feeds are replaced *by* bottle feeds)

- Absent breast milk secretion
- **In presence of contraindications of breast milk**
  - **Maternal contraindications**
    - Temporary: acute illness such as pneumonia or breast abscess.
    - Permanent: open TB, heart failure or any other chronic illness making the mother unfit to feed her baby.
    - Maternal hepatitis B is not a contraindication for breast feeding, but the baby should receive immediately after birth both hepatitis B immunoglobulin and vaccine).
  - **Infantile contraindications: metabolic problems**
    - Galactosemia.
    - Phenylketonuria.
    - Lactose intolerance.

Types of milk formulas

I. Formulas for healthy infants

Type	Modifications	Indications	Examples
1. **Humanized Formulas** (Standard)	. Modified to be very similar to breast milk in composition, quality and calories . Fat is replaced with vegetable oils . Minerals and vitamins are added . Some formulas are fortified with iron (better)	First choice for feeding healthy infants during the first 6 months of life.	. S26 . Nan 1 . Bebelac 1 . Enfamil 1

II. Formulas for diseased infants

1. **Lactose free formulas**	. Lactose is replaced usually with sucrose	. Lactose intolerance . Persistent diarrhea	. Bebelac FL . S26 FL
2. **Soya based formulas**	. Cow milk protein is replaced by soya protein Not used for routine feeding because of its high aluminum content	. Cow's milk allergy	.Bebelac soya
Both lactose free and soya based may be present in one formula for patient with persistent diarrhea			. Isomil
3. **Elemental formulas** (hypoallergic)	. Protein is hydrolyzed by enzymes to amino acids and small peptides . Fat in the form of medium chain triglycerides . It has bad taste and expensive	. Allergy to both cow milk and soy protein . Persistent diarrhea . Malabsorption e.g. cystic fibrosis	. Pregestmil . Neocat
4. **Preterm infant formulas**	. Higher calories: 80 calories/ 100ml . Higher protein . Lower lactose (pre term have less lactase enzyme) . Vitamins as vitamin E . Minerals (calcium-phosphorus) are added	. Preterm infant till reach the desired weight for hospital discharge	Enaflac premature formula
5. **Less commonly used formulas**: Phenylalanine free formula in Phenylketonuria and salt free formulas in heart failure and renal failure			

Program of formula feeding

1. Decide the *type of milk*
2. Determine the *number of feeds/ day*
    - Complementary and supplementary feeding: from 1 to 6 feeds depending on the condition
    - Substitutive feeding 6 feeds/ day on the average
3. Determine the *amount/feed*

    Age method in healthy infant with normal weight.
    - First month: 60 -90 ml/feed.
    - 2-3 months: 120-130 ml/feed.
    - 4-5 months: 140-150 ml/feed.
    - 6-7 months: 160-180 ml/feed.

    Weight method: more accurate, can be used in healthy and diseased infants.
    - Milk contains: 67 k cal. per 100 cc so each 150 ml milk provide 100 k cal.
    - Infant needs 100 k cal/kg/day, so he needs 150 ml milk/kg/day.
    - Infant receives 6 feeds /day, so the amount per feed equals 150/6= 25 ml/kg
    - Examples:

      Infant 5 kg infant: 5 x 25 = 125 ml / feed

      Infant 6 kg: 6 x 25= 150 ml/feed
4. Preparation: the following precautions are important.

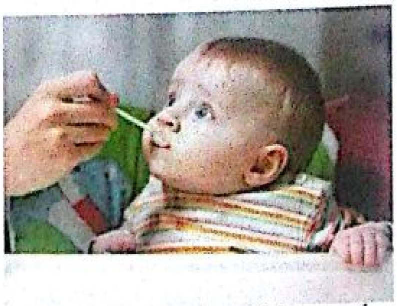
    Dilution
    - Formulas are available as dried powders that should be diluted with the proper amount of previously boiled water.
    - Over diluted formulas may result in malnutrition while over concentrated formulas may impair kidney function and hydration state).
    - Some formulas have big scoop (8 gram) e.g. S26 so dilution is 1 scoop/60ml water, other formulas have small scoop (4 gram) so dilution is 1 scoop/ 30 ml.

    Sterilization
    - All equipment should be sterilized before use (boiled for 5 minutes and then left to cool).
    - Prepared formula should be used immediately, remained amount should not be used again later (milk is good medium for bacterial growth)

Disadvantages of caw milk: why cow milk is not suitable below 1 year?

1. **General disadvantages**: expensive, liable to bacterial contamination
2. **Nutritional disadvantages:** lacking the quantitative and qualitative nutritional balance of breast milk (discuss from table)
3. **Immunological disadvantages** lacking the immunological values of breast milk (discuss)

Weaning



Definition

Introduction of food other than milk in the infant's diet

Onset time

At the age of 4 – 6 months because by that time:-

1. Iron stores become depleted.
2. Caloric value of milk becomes inadequate.
3. Digestive enzymes become mature.
4. The baby is developmentally ready for weaning
   - He can support his head and neck while feeding and can bring his hand to his mouth
   - Loss of extrusion reflex: he can transfer food from the front of the mouth to the back

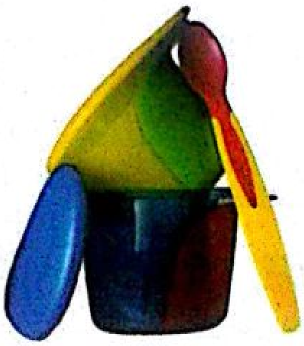
Extrusion reflex

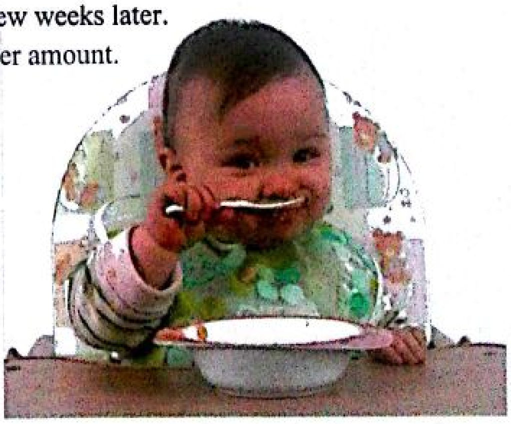
On attempt to spoon a very young infant, the infant tongue will push the spoon and food out

General rules (Principles)

New food items should be

1. Gradually introduced (Starting with small amounts).
2. Tried Separately with 2-3 weeks in between.
3. Given with Spoon not bottle and in an attractive way.
4. Given Before milk feeds and at fixed times.
5. Freshly prepared and have good taste
6. Changed if disliked by baby to be tried again few weeks later.
7. The infant Appetite's is the best index for proper amount.





Avoid

1. Introduction of common food allergens (Cow's milk, egg white) except after the 1st year
2. Excessive amount of breast milk or formula after 6 months as it may interfere with the introduction of sufficient amount of food needed for energy and iron.

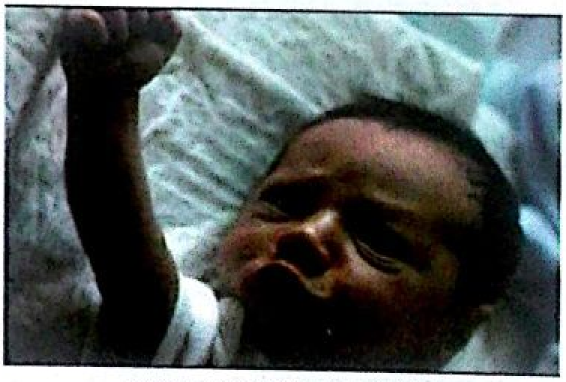
3. Excessive intake of fruit juices (may result in failure to thrive or obesity).
4. High risk chocking foods e.g. peanuts, nuts, row carrots or hard candy
5. Salt and spices.
6. Leaving the baby alone during feeding

Suggested program of weaning

- 4th month: iron fortified cereal mixed with baby's usual milk or water.
- 5th month: vegetable soup – lentils soap.
- 6th month: fruits as apple, pear or mashed banana- mixed vegetables.
- 7th months: egg yolk.
- 8- 9th month: can start to share the ordinary foods.
- 9-12th month: most table food is suitable provided soft and in small pieces.

Problems related to weaning

1. Food Allergy.
2. Colic and diarrhea.
3. Chocking.
4. Delayed weaning lead to :
    - Under nutrition
    - Rickets
    - Iron deficiency anemia
    - Sticking to breast milk



**BREAST IS THE BEST
NO WEANING!!**

Protein Energy Malnutrition

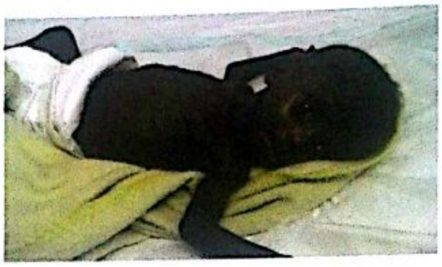
Classification or clinical spectrum

1. **Marasmus**: severe form of chronic caloric deficiency
2. **Kwashiorkor**: acute form of protein deficiency
3. **Marasmic kwashiorkor**: it is a mixed form of malnutrition
4. **Nutritional dwarfism**: mild to moderate form of chronic undernutrition
5. **Mixed forms**

Marasmus

Definition

It is a severe form of chronic undernutrition, in which the caloric supply of diet is insufficient to meet the minimum daily requirement.



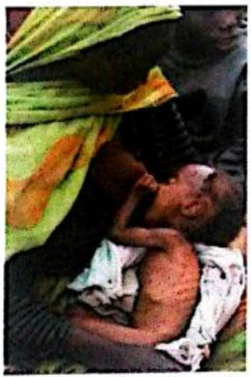
Incidence

Nutritional marasmus: 6 months- 18 months

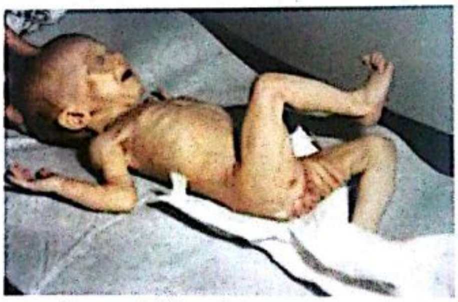
Etiology ↓↓ calories

Nutritional marasmus

1. Breast feeding: scanty breast milk.
2. Formula feeding: over diluted or infrequent intake



Nutritional marasmus



Non nutritional marasmus
Anomalies interfere with proper intake
Chronic infections
Metabolic disorders

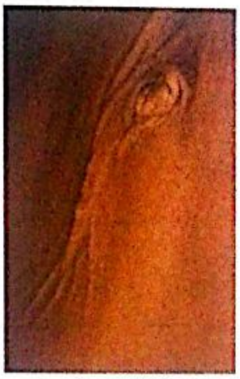
Non nutritional marasmus

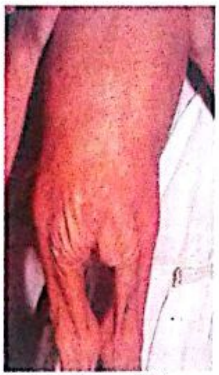
1. **Heart:** congenital heart disease.
2. **Respiratory:** tuberculosis, empyema, bronchiectasis and cystic fibrosis
3. **Gastrointestinal**: Chronic diarrhea, Cleft palate, Celiac disease, pyloric stenosis and esophageal stricture.
4. **Renal:** urinary tract infections and renal tubular acidosis
5. **Metabolic:** diabetes mellitus and inborn errors of metabolism

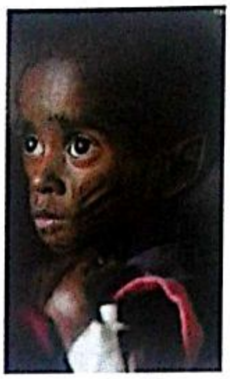
Clinical picture

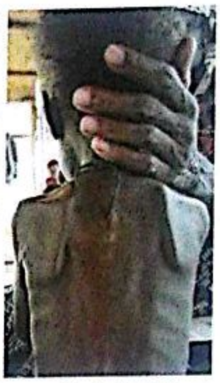
1. **Manifestations due to low caloric intake**
   - **Loss of subcutaneous fat, according to the site of fat loss, it is classified into**
     - **1st degree**: abdominal wall.
     - **2nd degree**: buttocks and thighs (and abdomen) .
     - **3rd degree**: generalized and involve face (buccal fat loss → senile facies).

       As a result Skin → thin and wrinkled.
       Bone→ marked bony prominence.
   - **Hypothermia** due to absence of subcutaneous fat and low metabolic rate.


Loss of fat
Abdominal wall


Loss of fat
Buttocks and thigh

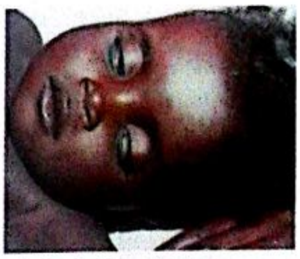

Loss of fat
Face

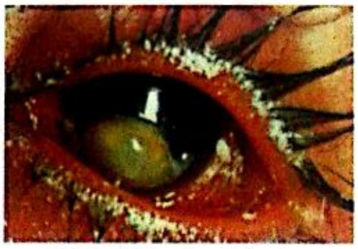

Marked bone
Prominence

2. **Manifestations due to low protein intake**
   - **Loss of weight** according to the degree of weight loss , it is classified into
     - First degree : weight loss between 15-25 % of the expected weight
     - Second degree : weight loss 25-35 %
     - Third degree :more than 35%
   - **Muscle wasting**
     - It is assessed by mid arm circumference.
     - If below 12 cm →severe muscle wasting

     Normal value: between 6 months and 6 years: above 15 cm

3. **Manifestations due to vitamin deficiency** e.g. Keratomalacia (vitamin A)
4. **Manifestations due to mineral deficiency**: Iron deficiency anemia
5. **Manifestations due to low water intake** (low milk intake): dehydrating
6. **Hungers**
   - Anxious look with continuous crying.
   - Hunger diarrhea: scanty dry greenish stools.


Dehydration: Sunken eyes


Keratomalcia

Complications

1. Infections due to impaired immunity.
2. Gastroenteritis →dehydration and electrolyte imbalance.
3. Hypothermia and peripheral cyanosis
4. Hypoglycemia.

Investigations in nutritional marasmus

Laboratory

1. Blood picture: type and degree of anemia, white cell count, and band cell ratio (infections)
2. Electrolytes: sodium and potassium and glucose
3. Serum iron and ferritin: iron deficiency anemia.
4. Stool analysis: intestinal infections and parasites
5. Urinalysis and culture (urinary tract infections)

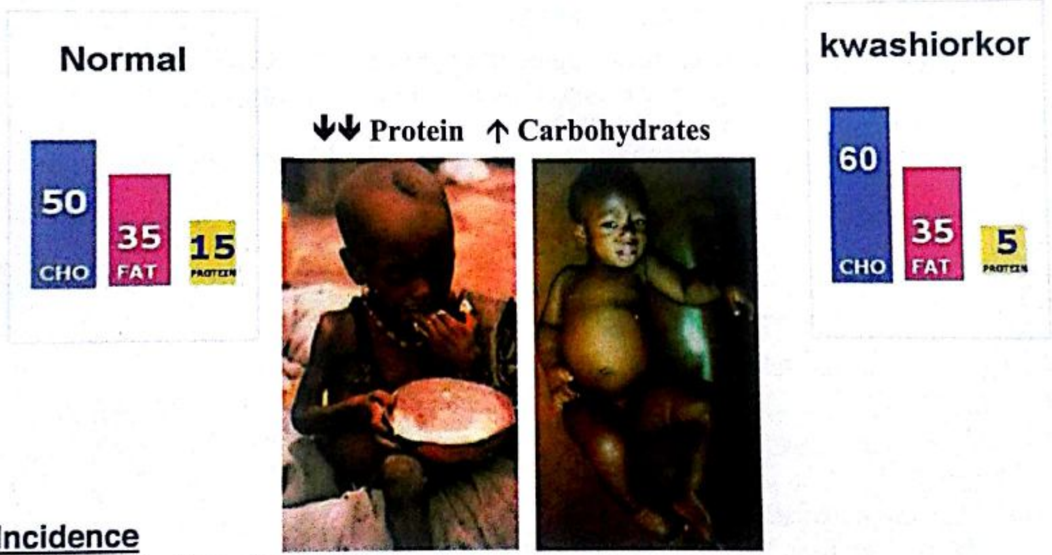
Imaging

1. Chest X ray.

Kwashiorkor

Definition

It is a severe form of acute malnutrition due to *severe protein deficiency* with an *adequate caloric intake* in the form of high carbohydrate diet.



Incidence

18 -24 months: time of weaning

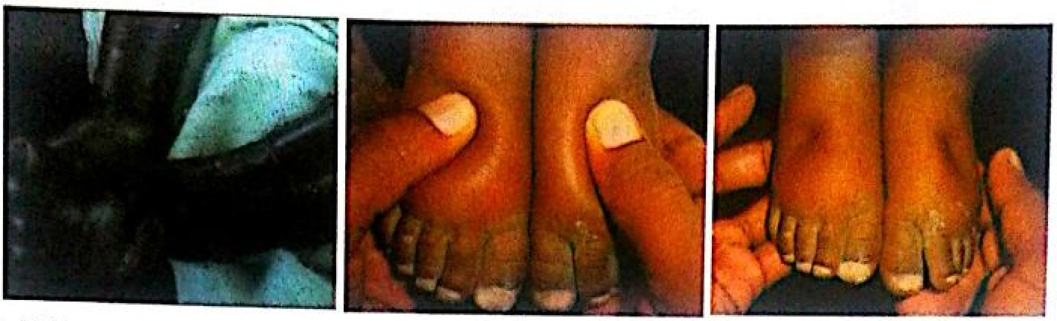
Etiology

1. **Dietetic error**
   - Wrong compensation of reduced milk intake (scanty breast milk, over diluted or infrequent formula feeding) by high carbohydrates diet e.g. starch, rice water)
   - Weaning phase: due to wrong substitution of milk with carbohydrates only.
2. **Infections**
   - Post gastroenteritis due anorexia, food restriction and malabsorption.

Clinical Picture (constant and variable manifestations)

Constant manifestations

1. **Edema:** it is the most essential feature.
   - **Picture**
     - Site of onset: starts in the dorsum of the feet
     - March: lower limbs, back of hands, arms, then it becomes generalized (rare ascites)
     - Character: pitting.



   - **Pathogenesis**

     Decreased protein intake → hypoalbuminemia→ decreased oncotic pressure of plasma protein →increased filtration.
     - Hypovolemia→renal ischemia → aldosterone secretion → Na and water retention.
     - Hemoconcentration stimulates antidiuretic hormone release → water retention

2. **Mental changes**
   - **Picture**

     . Apathy, lethargy and disinterest in the surroundings.
   - **Pathogenesis**
     - Disturbed amino acid metabolism.
     - Nicotinic acid deficiency.
     - Maternal deprivation.

3. **Growth Failure**

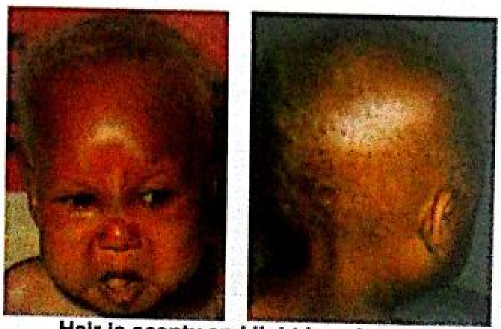
   Failure of weight gain is masked by edema and increased subcutaneous fat.

4. **Decreased muscle / fat ratio**

   Muscle atrophy due to protein depletion while excess fat due to high caloric intake
   Diagnosed by skin fold thickness

Variable manifestations

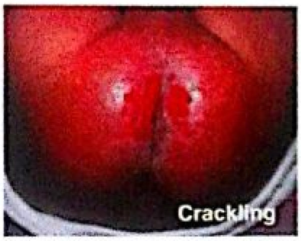
1. **Hair changes**
   - **Picture**
     - Sparse, easily detached and light in color.
   - **Pathogenesis**
     - Disturbed amino acid metabolism
       Low tyrosine→ decreased melanin).
     - Decreased copper which is responsible for elasticity and integrity of hair.

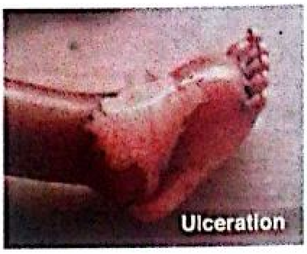


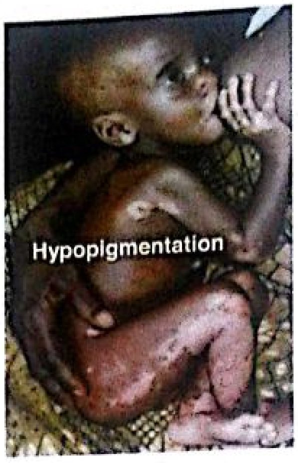
Hair is scanty and light in color

2. Skin changes

- **Picture**
  - Crackling , fissuring, ulceration and hypopigmentation
  - Sites: buttocks, perineum, back of thighs, and inguinal region.
- **Pathogenesis**
  - Disturbed amino acid metabolism.
  - Deficiency of Nicotinic acid, Vitamin A and Zinc.





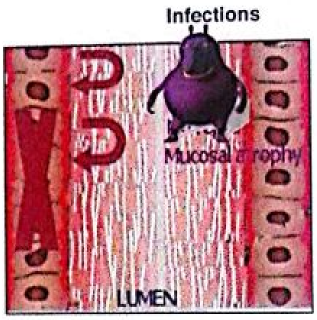


3. Hepatomegaly

- **Picture:** soft and smooth (fatty infiltration).
- **Pathogenesis**
  - Excess triglycerides due to excess carbohydrates.
  - Decreased lipotropic factors due to decreased protein.
  - The liver enlarge more with initiation of feeding (Nutritional recovery syndrome)

4. G.I.T. manifestations

- **Anorexia and vomiting**
  Due to mental changes and associated infections.
- **Diarrhea** due to
  - Infections and mucosal atrophy
  - Enzymatic deficiency(lactose intolerance)



5. Anemia

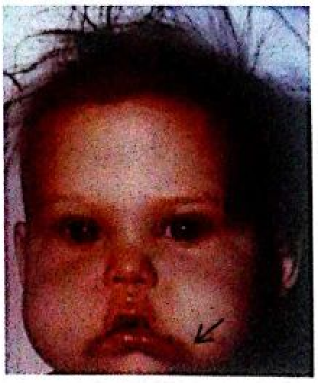
- **Dyshemopoietic**
  - Deficiency of protein (main factor), iron, Folic acid and B12
  - Bone marrow depression by associated infections →red cell hypolasia
- **Hemorrhagic**: hypoprothrombinemia (decreased vitamin K)
- **Hemolytic**: red cell destruction with sepsis

6. Vitamin deficiency

- **Vitamin A**: Keratomalacia
- **Vitamin B2:** ariboflavinosis (chelosis and glossitis)
- **Vitamin K**: bleeding

7. Infections due to immunodeficiency

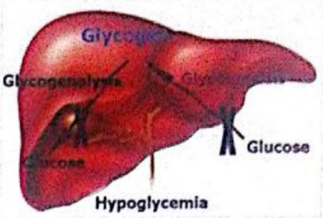
- Bronchopneumonia
- Diarrhea
- Skin infections



Chelosis: angular stomatitis+ cracking

× **Complications and causes of death in marasmus and kwashiorkor: P50**

Investigations



Laboratory

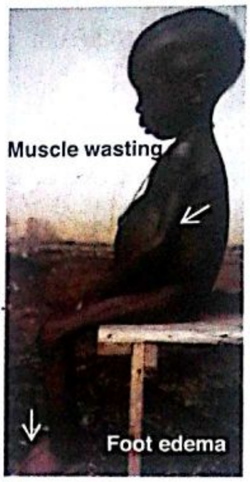
1. **Blood Picture** : anemia degree and evidence of infection
2. **Plasma proteins** :
   - Low total proteins. (Normal: 6-8 gm %)
   - Low serum albumin. (Normal value: 4-5 gm %)
   - Low serum alpha and Beta globulins but increased gamma globulins
3. **Glucose:** Hypoglycemia (impaired glycogenolysis). Normal: 80-120 mg/dl
4. **Electrolytes**
   - **Hypokalemia. (N: 4-5.5 mEq/L).** It is due to loss in diarrhea, low intake and effect of aldosterone.
   - **Hyponatremia. It is dilutional (N: 135- 145 mEq/L)**
     Total sodium increased (aldosterone), but serum sodium decreased (water retention)
   - **Hypomagnesaemia**.

Imaging

1. Plain chest X to exclude chest infection.

Differential diagnosis

- **Other causes of generalized edema**
  Renal - Hepatic - Cardiac- Allergic
- **Other diseases of protein energy malnutrition**



Marasmic kwashiorkor

1. **Marasmic kwashiorkor**
   Mixed form of malnutrition that occurs when:
   - Marasmic patient is fed on carbohydrate diet only without protein.
   - Kwashiorkor is subjected to carbohydrate restriction

   Diagnosis
   - Presence of edema in a marasmic patient.
   - Loss of subcutaneous fat in a case of Kwashiorkor.

2. **Nutritional dwarfism and failure to thrive**
   - It is the most common form of protein energy malnutrition.
   - Mild to moderate form of chronic under nutrition in early infancy
   - Underweight and short stature for age but no edema – no wasting.

3. **Comparison between marasmus and kwashiorkor**

	Marasmus	**Kwashiorkor**
Main feature	Wasting	Edema
Subcutaneous fat	Absent	Present
Muscle wasting	Present	Present
Appetite	Good	Poor
Complications	Less common	More common
Treatment	Easier, better prognosis	Difficult

Management of protein energy malnutrition

Hospital management for severe complicated cases

- **Indication**
  1. 3rd degree Marasmus.
  2. Kwashiorkor or marasmus kwashiorkor (edema and anorexia)
  3. Infections e.g. pneumonia, diarrhea or sepsis
- **Treatment of life threatening conditions is the initial line of management:-**
  1. Control of infection by proper antibiotics according to culture and sensitivity.
  2. Correction of shock, dehydration and electrolyte imbalance by I.V fluids.
  3. Correction of anemia by blood or packed red cells 10-15cc/kg.
  4. Prevention of hypothermia by adequate clothing and external heat.

Nutritional management for all cases

Marasmus	Kwashiorkor
1. Type • **Milk** : in non-weaned infants • **Balanced diet** in weaned infants	• **Milk** Start with soy based lactose free formula (lactose intolerance), then gradually shift to humanized formulas • **Other food** · Animal protein (high biological value): eggs, chicken, meat and yogurt. · Plant protein: lentils, beans · Fresh vegetables and fruits
2. Amount • **High caloric diet: 150-200 Kcal / kg / day.** Calculation according to actual weight and gradually increase according to the infant's tolerance.	• **High protein diet: 4-6 gram /kg/day**
3. Route • **Orally** (good appetite)	• **Nasogastric** may be required (anorexia) • **Parenteral feeding** may be required in severe cases
Vitamins and minerals • Vitamin A, single dose: 100 000 IU (from 6 months to one year) - 200 000 IU (more than 1 year) • Others: Vitamin B complex, C, D, E , Folic acid, iron (4-6 mg/kg/day) and zinc	

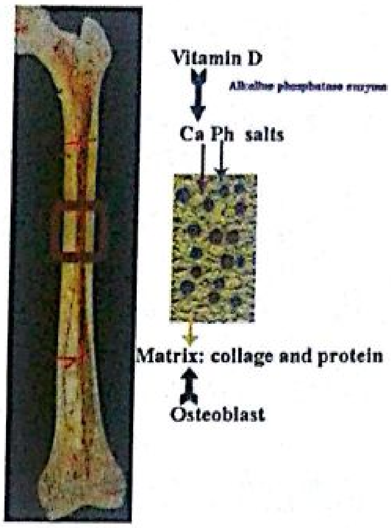
Prevention of protein energy malnutrition

1. Maintenance of successful breast feeding (the most important): discuss
2. Health education about feeding and proper weaning.
3. Early diagnosis of mild cases.

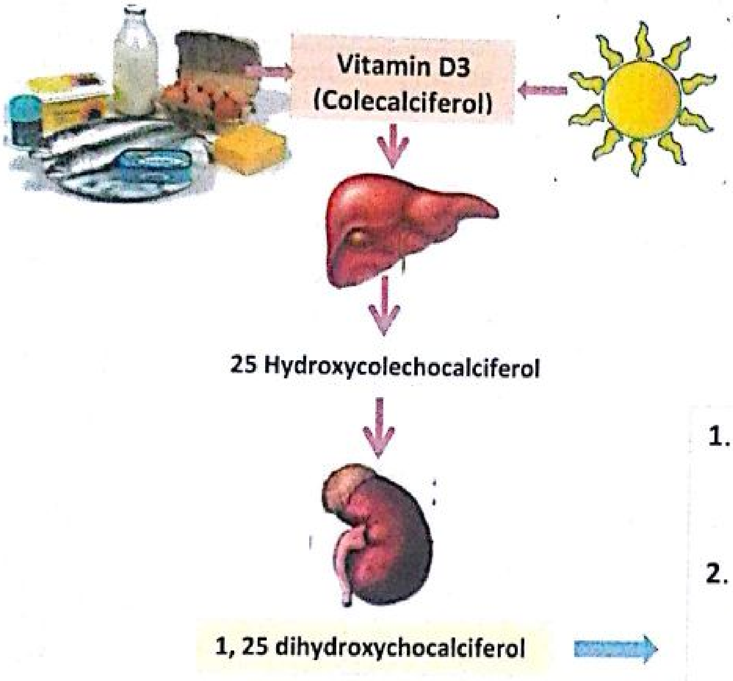
Rickets

Physiological and pathological background

- **Bone**
  - It is a major reservoir for Calcium and Phosphorus.
  - It is formed of:-
    - Protein matrix = osteoid tissue
    - Ca-phosphate crystals. Deposited in this matrix

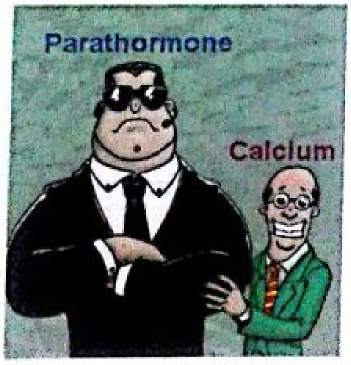


- **Vitamin D**



1. **Intestine**: Increased calcium and phosphorus absorption
2. **Kidney**: Increased phosphorus and calcium reabsorption
3. **Bone**: increased calcium and phosphorus deposition

- **Parathormone**



1. **Intestine**
   Increased calcium absorption
2. **Kidney**
   Decreased phosphorus reabsorption
3. **Bone**
   Increased bone depletion

Biochemical response to decreased vitamin D

Decrease Vitamin D

1. **Intestine**: decrease Calcium and phosphorus absorption
2. **Kidney**: decrease phosphorus and calcium reabsorption
3. **Bone**: decrease Calcium and phosphorus Deposition

↓

Decrease serum Calcium and phosphorus

→

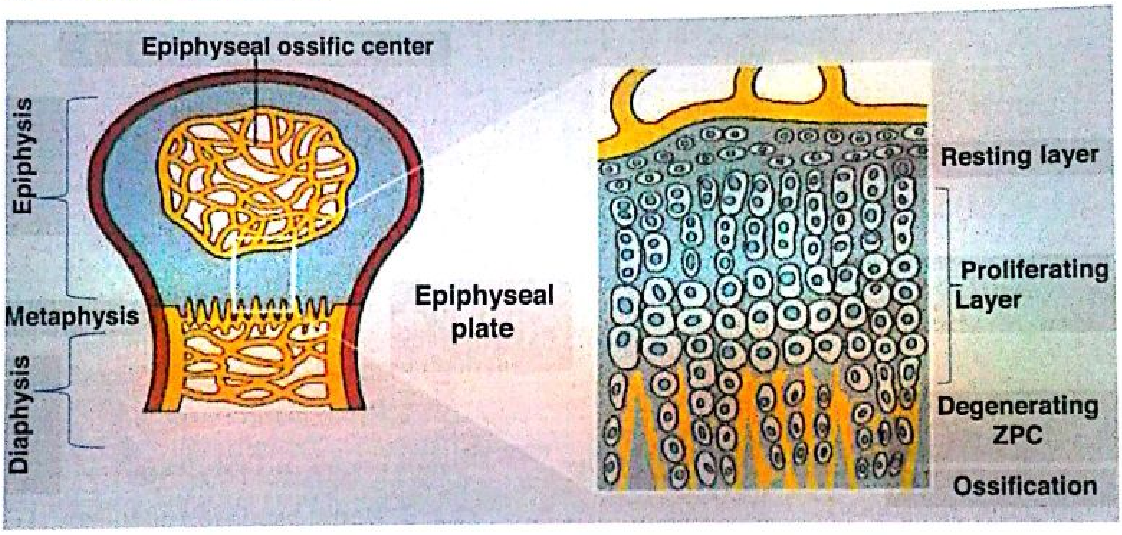
Increase Parathormone level

1. **Intestine**
   Increased Ca absorption
2. **Kidney**
   Decreased phosphorus reabsorption
3. **Bone**
   Increased Ca reabsorption

↓

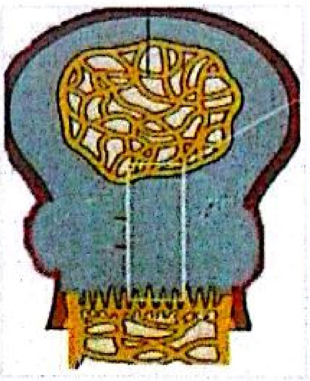
Normal serum Calcium, decreased serum phosphorus

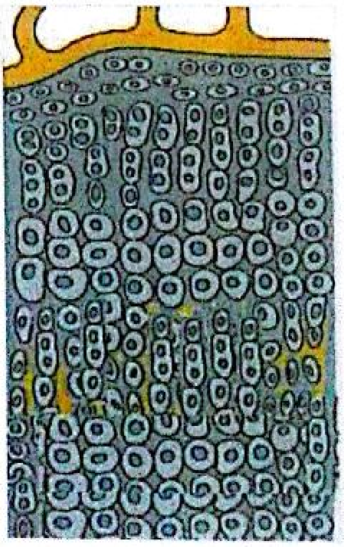
Normal bone formation



Rickets

1. **Proliferation of cartilage without degeneration → Broadening**
2. **Defective bone formation**
3. **Soft bone→ Deformities and fractures**





Infantile Vitamin D Deficiency Rickets

Incidence

The most common type
Age incidence: 6 months to 2 years.

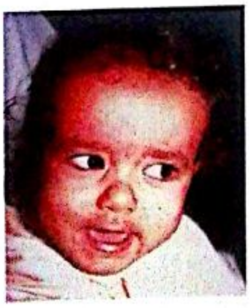
Etiology

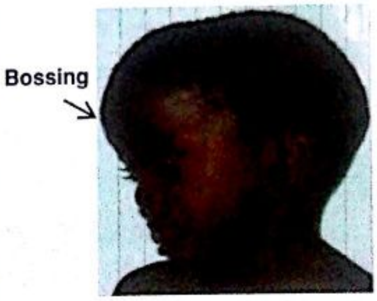
1. **Inadequate intake of vitamin D**
   - Prolonged breast feeding without vitamin D supplementation.
   - Racitogenic diet (diet poor in vitamin D or interfere with bioavailability of calcium and phosphorus)
     - Poor in vitamin D e.g. milk and carbohydrates.
     - Non optimum calcium / phosphorus ratio e.g. cow's milk.
     - Increased phytic acid which precipitates Ca as phytate e.g. cereals.
2. **Inadequate exposure to sun rays (U.V rays)** : dark skinned people are more at risk

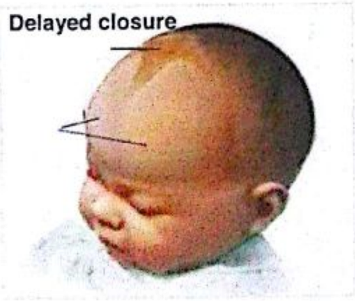
Clinical Manifestations

Skeletal manifestations

1. **Head**
   - **A**symmetry and enlargement of the skull
   - **B**ossing at the frontal and parietal eminence →square forehead and square vault.
   - **C**raniotabes: pressing on the skull bone along the lumbdoid suture, it yield like a ping pong ball
   - **D**elayed closure of anterior fontanel and **D**elayed dentition.

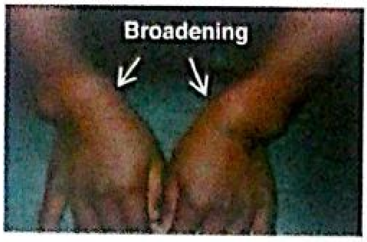


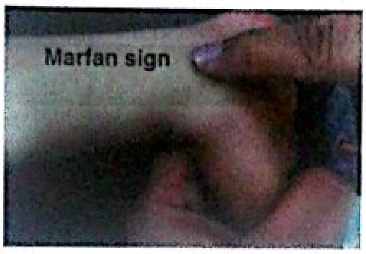


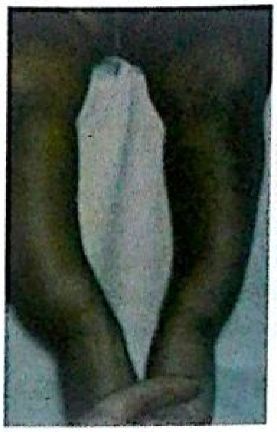


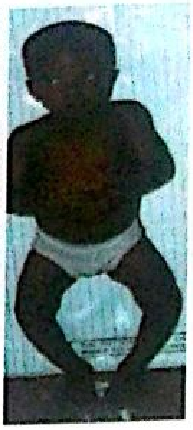
2. **Upper and lower limbs**
   - **Broad ends of long bones** (wrists and ankles).
   - **Marfan sign**: transverse groove felt on palpation the medial malleoli.

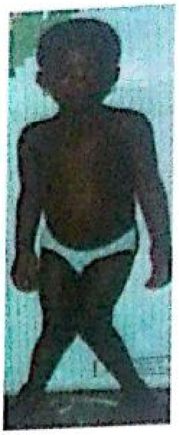
- **Deformities**: due to weight bearing and muscle traction on soft bones,
  - In creeping infants: upper limbs are affected: convexity of radius and ulna
  - In walking children: lower limbs are affected (bow legs : Genu varum), or (knock knees: Genu valgum)





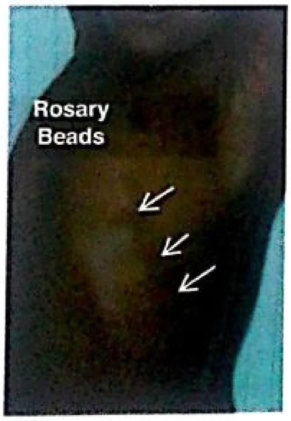

Broad lower ends
Genu varum

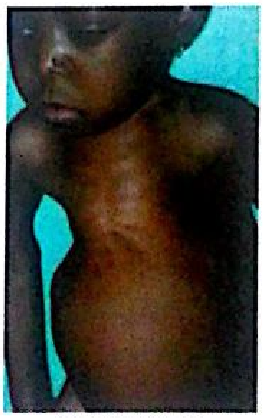

Genu varum
(Bow legs)

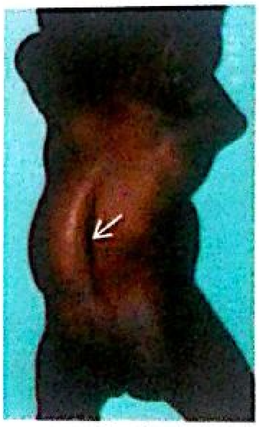

Genu valgum
(Knock knees)

3. Thorax

- **Rosary beads:** broadening at the costochondral junctions.
- **Harrison sulcus:** horizontal groove along the lower part of the chest (diaphragm insertion)
- **Longitudinal sulcus:** vertical groove at the sides of the thorax just behind rosary beads
- **Chest deformities:** Pigeon chest (protrusion of the sternum and flaring out of lower ribs).




Pigeon chest
Abdominal distention


Scoliosis

4. Spine

- Scoliosis.
- Kyphosis only when sitting (correctable on straightening the back)
- Lumbar lordosis when standing

Muscles and ligaments hypotonia

Generalized hypotonia and laxity of ligaments due to hypophosphatemia resulting in:

1. **D**elayed sitting, standing and walking.
2. Abdominal **D**istention due to
   - Displacement of liver and spleen downwards(ligaments laxity)
   - Hypotonia of the abdominal muscles.

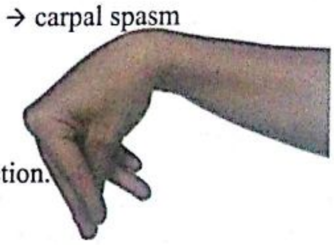
Neurological Manifestations: hypocalcemic tetany

Etiology: decreased ionized calcium occurring in:

1. Severe cases (bone markedly depleted of Ca).
2. High dose vitamin D injection→rapid mobilization of blood calcium to bones.

Clinical picture

1. **Latent tetany: serum calcium 7-9 mg %**
   Clinical signs of tetany are not evident, provocation tests are needed to elicit them
   - Tapping of facial nerve→ spasm of lips, nostrils and eyelids
   - Tapping of fibula over peroneal nerve→ pedal spasm
   - Constriction of the upper arm with sphygmomanometer → carpal spasm
2. **Manifest tetany*: serum calcium less than 7 mg%***
   - Convulsions
   - Carpopedal spasm
   - Laryngeal spasm may lead to stridor and airway obstruction.



Complications

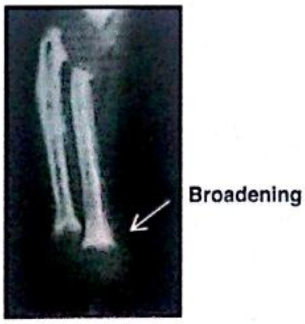
1. **Respiratory:** Infections and atelectasis due to :
   - Chest deformities that interfere with proper expansion.
   - Hypotonia of respiratory muscles→ weak cough reflex.
2. **Neurological:** tetany.
3. **Iron deficiency anemia** is a common association (breast milk is deficient in both)

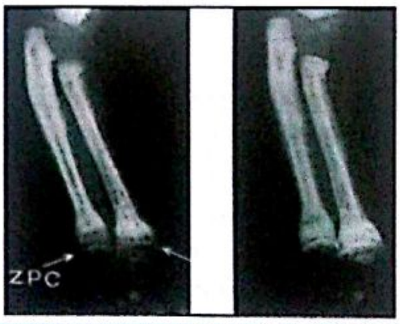
Investigations

Laboratory (during the active stage)

1. Serum calcium, total and ionized: **normal** (N: 9-11 mg/dl) - when it decrease?? tetany causes
2. Serum phosphorus: **decreased** (N: 4.5: 6.5 mg/dl)?
2. Serum alkaline phosphatase: **increased** (the earliest manifestation)

Radiological

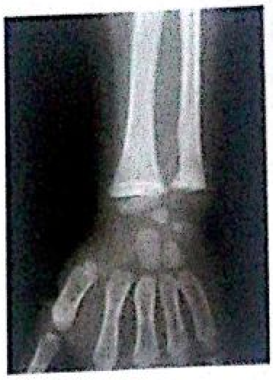




1. Active rickets	**2. Healing rickets:** 2 weeks of vitamin D therapy
Epiphysis: Joint space: wide (translucent non calcified area)	
Metaphysis Frayed (irregular)epiphyseal line Cupping (widening) of metaphyseal area	No fraying Concave continuous line of calcification at the lower end of long bone : Zone of Provisional Calcification
Diaphysis Rarefaction = decreased bone density Pathological fractures (green stick)	Improving bone density

3. **Healed rickets:** 4 weeks of vitamin D therapy
   Epiphysis: Normal joint space
   Metaphysis
   - Straight dense transverse line
   - Osteoid tissue is calcified and united with the shaft

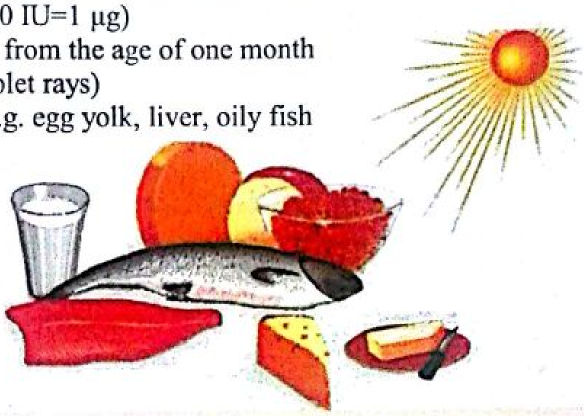
   Diaphysis
   - Improved bone density
   - Deformities may persist



Treatment

1. Preventive treatment

- Vitamin D orally, daily from the second month of life :
  - Full term: 400 IU. (40 IU=1 μg)
  - Preterm: 400-800 IU from the age of one month
- Exposure to sun (ultraviolet rays)
- Diet rich in vitamin D. e.g. egg yolk, liver, oily fish



2. Specific treatment

Vitamin D therapy: Oral OR injection, vitamin D deficiency rickets is sensitive to vitamin D in ordinary doses.

- **Oral treatment**: daily for 2- 4 weeks.
  - Vitamin D3 : 2000-5000 IU/day (50-150 μg/day) OR
  - 1 alpha vitamin D (active form) 0.5- 1 μg/kg/day.
- **I.M injection:** 600,000 IU single injection
  - If no healing occurs, the rickets is probably resistant to vitamin D.
  - Injection treatment may be better than oral treatment because of :
    - More rapid healing.
    - Less dependence on parents for daily administration.
    - Earlier differential diagnosis from vitamin D resistant rickets
- **Instructions to the parents**
  - Diet rich in vitamin D.
  - Proper sun exposure.
  - After treatment Vitamin D is given by usual maintenance dose : 400 IU daily

3. Treatment of complications

- Tetany: 1 ml/kg calcium gluconate 10% I.V. slowly to be accompanied by oral calcium
- Treatment of iron deficiency anemia by oral iron therapy 6 mg/kg/day
- Deformities: surgical treatment for severe and persistent cases.

Hypervitaminosis D

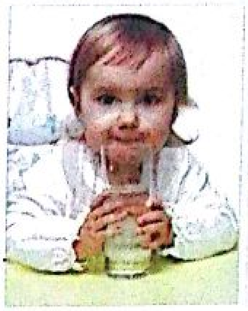
Etiology

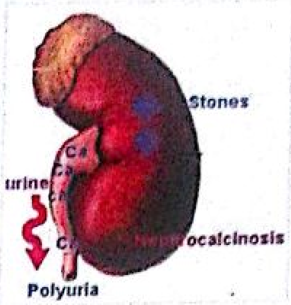
Excessive intake of vitamin D

1. Repeated IM injection.
2. Prolonged administration of daily doses of 2000 IU

Clinical Picture

1. G. I.T.: Anorexia, vomiting, constipation.
2. Kidney
   Polyuria and Polydipsia
   Renal stones and Nephrocalcinosis
   Renal failure.
3. Metastatic calcification (blood vessels-heart).





Investigations

1. Serum calcium: hypercalcemia (above 11 mg/dl)
2. Urinary calcium: hypercalciuria.

Treatment

1. Immediate stoppage of vitamin D and calcium.
2. Oral corticosteroids (decrease calcium absorption).

Non vitamin D deficiency rickets (late – Refractory- non nutritional)

1. Renal rickets

- **Renal glomerular rickets: renal failure**
  Decreased activity of 1 hydroxylase→ Failure of vitamin D activation
- **Renal tubular rickets**
  - Vitamin D resistant hypocalcemic rickets
  - Vitamin D resistant hypophosphatemic rickets (familial hypophosphatemia)
  - Other rare defects:
    - Fanconi syndrome: phosphaturia, glucosuria and aminoaciduria.
    - Lignac syndrome: As Fanconi. + cystinosis.
    - Lowe syndrome : Oculo-cerebro-renal syndrome.
    - Lightwood syndrome : Infantile renal tubular acidosis.

2. **Hepatic rickets** in chronic liver disease due to defective activation of vitamin D

3. **Malabsorption:** Celiac disease, Cystic fibrosis, Cholestasis and Chronic diarrhea

Remember

- Treatment of vitamin D resistant rickets is by active from of vitamin D.
- Anticonvulsants drugs e.g. Phenobarbital and phenytoin increased utilization of the vitamin and can cause rickets
- Rickets is impaired mineralization of the growing bone while osteomalacia is impaired mineralization of mature bone
- Early neurological manifestations rickets may include : anorexia, and excessive sweating

Clinical presentations of cardiac diseases

1. **Murmurs: the most common presentation.**
2. **Central cyanosis.**
3. **Heart failure: emergency chapter.**
4. **Shock: emergency chapter.**

Murmurs

Laminar flow

Normal

Turbulent flow

Murmur

	Innocent cardiac murmurs	Organic murmurs
Definition	Murmurs that are not associated with anatomic or hemodynamic abnormality. Present in 30% of children.	Murmurs that are associated with anatomic abnormalities.
Etiology	Turbulence of blood flow at the origin of the great arteries: the great arteries arise from the ventricles at a slight angle and are relatively narrower than the respective ventricle from which they arise	Turbulence of blood flow across a defect or abnormal valve.
History	Asymptomatic	Cardiac symptoms are present.
Examination		
▪ Thrill	Not accompanied by thrill	Thrill may be present
▪ Sounds	Normal heart sound	Normal, muffled or accentuated
▪ Murmurs		
Site	Left sternal edge or below clavicle	Any area
Area	No propagation	Characteristic propagation
Character	Soft (never harsh) faint : grade 1 or 2	Harsh or soft
Timing	Systolic (except venous hum which is continuous)	Systolic or diastolic or continuous
Investigations	Normal: X ray, ECG , Echocardiogram	Abnormal
Treatment	Reassurance	Medical and surgical treatment

Types of innocent murmurs

	Classic vibratory murmur: Still's murmur (The commonest)	Physiologic pulmonary flow murmur	Venous hum
Origin	Unknown (may be turbulence of blood flow in the left ventricle outflow	Turbulence of blood flow in the right ventricle outflow	Turbulence in the jugular venous system
Site	Left sternal edge	Pulmonary area	Below the clavicles
Timing	Mid-systolic	Mid-systolic	Continuous
Characters	. Musical or vibratory . High with increase cardiac output e.g. exercise	. Soft . High with increased cardiac output e.g. exercise	. Blowing . Disappears in supine position

Types of organic murmurs: SACT

- **Valvular lesions**

1. Mitral regurgitation: apical harsh pansystolic murmur propagated to the axilla.
2. Mitral stenosis: apical rumbling mid diastolic murmur.
3. Aortic regurgitation: soft early diastolic murmur over the aortic area.
4. Aortic stenosis: rough loud ejection systolic murmur over the aortic area.
5. Pulmonary stenosis: ejection systolic murmur over the pulmonary area.

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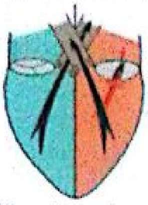
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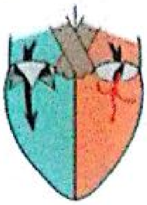
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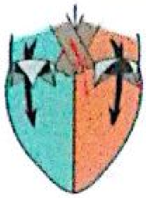
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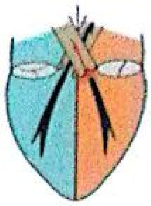
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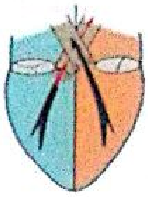

- **Shunt lesions**

1. VSD: harsh pansystolic murmur in the left parasternal area.
2. ASD: ejection systolic murmur over pulmonary area.
3. PDA: continuous machinery murmur over the pulmonary area.

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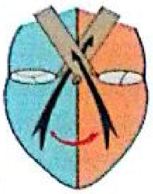
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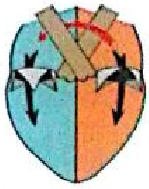
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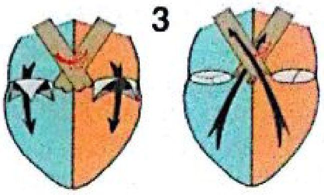
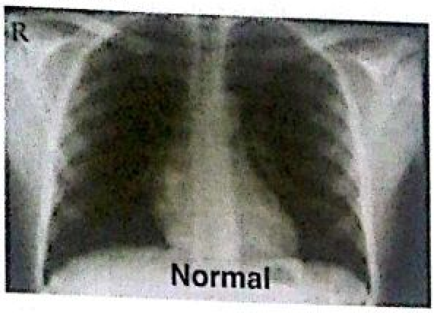


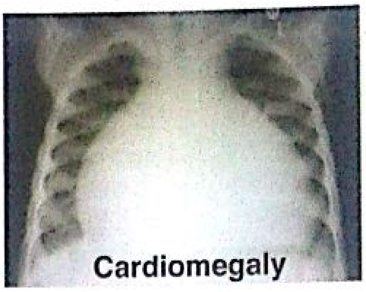
Cyanosis

	Central	Peripheral
Definition	Bluish discoloration of the skin and mucous membrane due to increased amount of reduced hemoglobin in the blood	
Pathophysiology	Poor lung function or abnormal heart → abnormally oxygenated blood passes outside the heart containing reduced hemoglobin < 5 gram/dl	Poor circulation → stagnation of normally oxygenated blood in the periphery
Etiology	1.Respiratory failure causes: enumerate 2.Congenital cyanotic heart: enumerate	1. Heart failure 2. Shock 3. Cold extremities
Clinical differences	All body is blue (the tongue is blue)	Usually nail beds and nose tips Tongue is normal
	Clubbing and polycythemia present	Absent
	Worm extremities	Cold extremities
Lab. differences	Arterial Oxygen saturation ≤ 85 %	Usually normal

Investigations of cardiac diseases

1. **X ray**
   - Heart site, size , shape and which chamber enlarged
   - Pulmonary vascularity: normal or decreased (lung oligemia) or increased (lung plethora)





2. **ECG**
   - Arrhythmia diagnosis
   - Chamber enlargement

3. **Echocardiography**: the most important
   - Defect e.g. VSD: site and size of the defect
   - Direction of blood flow with the use of color flow Doppler
   - Chambers size
   - Cardiac functions e.g., Degree of contractility
   - Pulmonary artery pressure

Trans-esophageal Echo
Better image, when transthoracic image is inadequate

4. **Cardiac catheterization**

Rarely required to make the diagnosis and is now indicated when additional anatomic information is needed before operation and for intervention.

Pressure and oxygen saturation are measured in each chamber and blood vessels entered, this data used to calculate systemic and pulmonary blood flow and systemic and pulmonary vascular resistance.

Rheumatic fever

Definition

Autoimmune inflammatory disease involving mainly the heart, joints and less frequently, the central nervous system, skin and subcutaneous tissues.

Etiology

- It follows infection with group A Beta hemolytic streptococci of the pharynx (not the skin)
- A latent period 2-3 weeks is present between throat infection and the onset of disease,

Predisposing factors

- Age between 5-15 years.
- Family history of rheumatic fever
- Low socioeconomic status with overcrowding and improper ventilation

Pathogenesis

The most accepted theory is that it is an autoimmune disease. Antibodies formed against streptococcal antigen can react with cardiac muscles (cross reactivity).

Diagnosis

Major criteria

- **Polyarthritis**
- **Carditis**
- **Chorea**
- **Erythema marginatum**
- **Subcutaneous nodules**

Minor criteria

- **Pyrexia:** usually present at the onset, (at least 38C)
- **Previous rheumatic fever**
- **Prolonged PR interval** (not sepecific for acute rheumatic fever)
- **Arthralgia:** joint pain without objective findings of arthritis
- **Acute phase reactants :** raised (ESR,CRP) - leukocytosis

Evidence of recent strepto. Infection

- **Recent scarlet fever**
- **Positive throat culture**
- **Antistreptococcal antibodies e.g. Antistreptolysin O (ASOT), Antistreptokinase and antihyaluronidase**

Diagnosis of rheumatic fever is based on revised Jones criteria:-

The presence of 2 major criteria OR 1 major and 2 minor criteria, Plus Evidence of recent streptococcal infection.

The following tips are important in applying Jones criteria

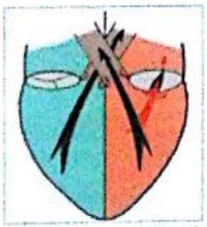
- Diagnosis based on **2 major** criteria is stronger than that based on **1 major and 2 minor.**
- **Arthralgia** cannot be considered a minor manifestation if **arthritis** is a major manifestation.
- Prolonged PR interval cannot be considered a minor criteria if carditis is a major criteria
- Acute phase reactant (leukocytosis- elevated ESR and CRP) are all **one minor** criteria.
- Evidence of recent streptococcal infection **is essential for diagnosis.**
  ASOT titre is more liable than throat culture (because throat culture can't differentiate between recent infection and chronic pharyngeal carriage
- Patients with recurrences or isolated chorea may not fulfill the Jones criteria

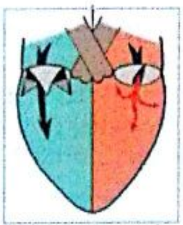
1. Polyarthritis

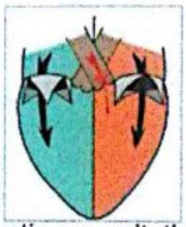
- It is the most common presentation (75% of cases).
- Polyartricular: affecting more than one joint.
- Large joint affection: knee, ankles, wrist, elbow less commonly the hips.
- The affected joint is hot, red, tender and swollen with limitation of movement.
- It migrates from one joint to another (one joint is improving as the other becomes worse)
- It shows dramatic response to salicylates (within 48 hours).
- It Leaves the joint completely free (no permanent deformity)
- Persists for 3-4 weeks then disappears spontaneously even without treatment.

2. Carditis

- It is second most common presentation after arthritis (50% of cases)
- It is usually pancarditis.
  - **Endocarditis**
    - Left side valves: mitral valve affection is more frequent than aortic valve; however both may be affected together.
    - Mitral valve regurgitation (pansystolic murmur at the apex) is present in the acute stage of the disease, later, in the chronic stage scarring of the mitral valve may lead to stenosis (mid diastolic murmur at the apex): carey coombs murmur.
    - Aortic valve regurgitation is detected by early diastolic murmur along the left sternal border (isolated aortic valve affection is rare).


Mitral regurgitation
Systole


Mitral stenosis
Diastole


Aortic regurgitation
Diastole

  - **Myocarditis** Cardiac output = stroke volume x heart rate
    - Tachycardia disproportionate to fever.
    - Muffled heart sounds
    - Heart failure may occur in severe cases
  - **Pericarditis**
    - Precordial pain
    - Pericardial rub by auscultation

Carditis is the most serious manifestation of rheumatic fever as it may be fatal during the acute stage and later on it may result in chronic valve lesions.

3. Chorea (Sydenham chorea): 15%

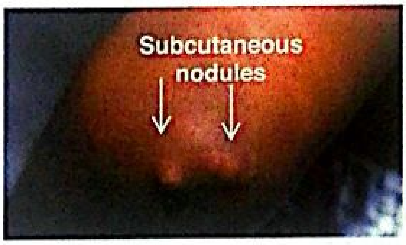
- It is more common in females.
- It occurs much later than other rheumatic manifestations, the latent period following streptococcal pharyngitis may be as long as 4 months
- Associated with other rheumatic manifestations in 10% of cases usually with carditis.
- It may be the only manifestation of rheumatic fever
- Subsides gradually in 6 to 7 months ,usually without permanent neurological sequelae
- **Manifestations include:**
  - **Choreic movements**
    - Involuntary Irregular
    - Static Sudden jerky
    - Purposeless, Proximal more than distal,
  - **Hypotonia** is evident by
    - Pendular knee jerk.
    - Inability to maintain extended arms or hand grip.
  - **Emotional lability**

4. Erythema marginatum (less than 10%)

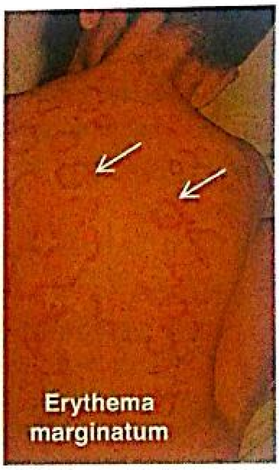
- Red non pruritic macules that fade centrally
- Appears over the trunk, legs but never in the face.
- It disappears on exposure to cold, and reappears after hot bath

5. Subcutaneous nodules (2 % to 10%)

- Small, rounded, hard, painless and freely movable.
- Present over the bony prominences e.g. elbow etc...
- Never present alone.



Subcutaneous nodules



Erythema marginatum

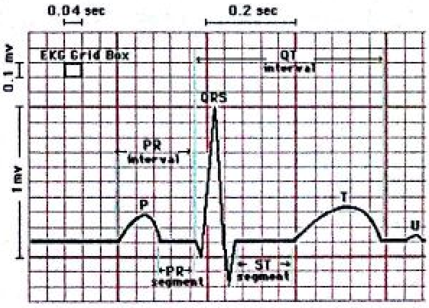
Investigations

Laboratory

1. Evidence of recent streptococcal infection
   - Anti-streptolysin O titer over 200 units (normal : below 150 Todd units)
   - Other antibodies e.g. anti-streptokinase, antihyaluronidase.
   - Throat swab is usually negative (organism disappear from the pharynx)??
2. Presence and degree of inflammation (acute phase reactants)
   - Erythrocyte sedimentation rate (normal: first hour 3-7 millimeters per hour. Second hour 8-15 millimeters per hour).Values more than 50 mm/hour are suggestive of rheumatic fever.
   - C reactive protein (normal level : less than 10 mg/L)
3. Investigations are normal in isolated chorea due to long latent period.

Imaging

1. ECG: prolonged PR interval, wide QRS and elevated ST segment (pericarditis)
2. X ray: cardiomegaly may be present.
3. Echocardiography
   - Detect valvular lesions.
   - Assess myocardial contractility.
   - Exclude possibility of pericardial effusion.



Differential diagnosis

1. Arthritis from other causes of arthritis: discuss P 253
2. Carditis from other causes of carditis e.g. viral myocarditis
3. Chorea From other causes of chorea e.g. drug induced chorea

Prevention

Primary prevention

1. Prevention of streptococcal infection e.g. proper ventilation
2. Early diagnosis of streptococcal pharyngitis, then,
3. Adequate treatment by: single injection of Benzathine penicillin 1,200.000 IM or oral course of penicillin for at least 10 days (Erythromycin 40 mg/kg/day in those allergic to penicillin).
4. Primary prevention is difficult as 30% of streptococcal pharyngitis patients are asymptomatic

Secondary prevention: Prevention of rheumatic activity in patient with previous rheumatic fever

1. Benzedrine penicillin 1,200.000 IM every 2 weeks in winter, every 3 weeks in summer
   - For life in patients with residual heart disease or artificial valve.
   - To the age of 18 years in patients with no cardiac affection.
   - To the age 25 years in patients with documented carditis
2. Other methods (not effective): oral daily penicillin V or sulphisoxazole or erythromycin

Treatment

Supportive treatment

Rest: patients with carditis should have absolute bed rest for at least 4 weeks

Specific treatment

1. **Arthritis**
   . Salicylates(aspirin): 100 mg /kg/ day for 2 weeks then 75 mg/ kg/day for 2-3 weeks.
2. **Carditis**
   Severe carditis with cardiomegaly
   - Prednisone 2 mg/kg/ day 4 divided for 2 weeks, then taper (↓the dose 25% each week)
   - Salicylates 75 mg /kg/day: overlapping therapy (during tapering) for 6 weeks to avoid post steroid rebound.

   Mild to moderate carditis with no cardiomegaly
   - Salicylates100 mg /kg/ day then gradual withdrawal over 4 to 6 weeks guided by ESR
3. **Chorea**
   - Phenobarbitone: 15 to 30 mg/day every 8 hours OR
   - Haloperidol 0.5 mg to 2 mg/day every 8 hours
4. **Antibiotic therapy** with IM Benzathine penicillin 1,200.000 (Erythromycin 40 mg/kg/day in those allergic to penicillin).

Treatment of complications: heart failure: see emergency P

1. **Preload reducing agents**: diuretics e.g. Furosemide 2 mg/kg / day.
2. **Inotropes:** digoxin used with caution , begin with half the usual dose (some patients with rheumatic carditis are supersnsive to digitalis→ arrhythmia)
   Digitalizing dose: 0.02-0.05 mg/ kg.
   Maintenance dose: 0.01 mg /kg/ day.
3. **After load reducing agents** (vasodilator e.g. Captopril 0.6 -2 mg/kg/day)

× **The major complication of rheumatic fever is the development of rheumatic valvular heart**

Rheumatic heart disease: revise clinical book

1. **Etiological diagnosis**
2. **Anatomical diagnosis (what valve affected, and what chamber enlarged)**
3. **Functional diagnosis**
4. **Presence or absence of activity**
5. **Presence or absence of complications**

1. Etiological diagnosis

The following criteria are suggestive of rheumatic origin:-

- Age above 5 years
- History of recurrent attacks of tonsillitis
- Documented previous history of rheumatic fever
- Multiplicity of valvular lesions with predominant affection of mitral valve

2. Anatomical diagnosis

- **Valvular lesions can be detected by auscultation of the different cardiac areas.**
    - Mitral regurgitation: apical harsh pansystolic murmur propagated to the axilla
    - Mitral stenosis: apical rumbling mid diastolic murmur
    - Aortic regurgitation: soft early diastolic murmur over the aortic area
    - Aortic stenosis: rough loud ejection systolic murmur over the aortic area.
- **Chamber enlargement**
    - Left ventricular enlargement: localized apex, shifted downward and outward.
    - Rt ventricular enlargement: diffuse apex , shifted outward- left parasternal and epigastric pulsation
    - Pulmonary artery dilatation: pulsation on the second left space.

3. Functional diagnosis

Heart failure may be left side heart failure or both left and right

- **Left side heart failure**: dyspnea, orthopnea, paroxysmal nocturnal dyspnea-
- **Rt side heart failure**: congested neck veins, enlarged tender liver and lower limb edema.

4. Presence of activity

- Major manifestations of activity : arthritis, carditis, chorea, erythema marginatum and subcutaneous nodules.
- Minor manifestations of activity.
- Investigations of rheumatic activity (or fever).
- Modified Jones criteria in short.

5. The presence of complications

- **Acute complications**
    - Infective endocarditis diagnosed by fever, clubbing, splenomegaly and embolic manifestations.
    - Acute heart failure
    - Chest infection due to pulmonary congestion.
    - Atrial fibrillation
- **Chronic complications**
    - Chronic congestive heart failure and pulmonary hypertension.

Congenital heart disease

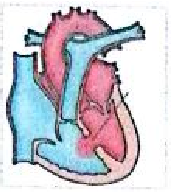
Incidence

- The commonest cause of heart disease in children.
- 8 per 1000 live-born infants have significant cardiac malformations
- 10-15% has complex lesions with more than one cardiac abnormality
- 10-15% has associated non cardiac malformations: **When structural abnormalities of other systems are present, consider echocardiography for associated cardiac disorders**

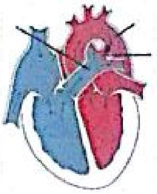
Classification

Acyanotic congenital heart lesions: 80%

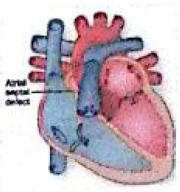
1. **With left to right shunt (increased pulmonary blood flow: lung plethora)**
   - VSD Ventricular septum defect: the most common: **30%**
   - PDA Persistent ductus arteriosus: **5-10 %**
   - ASD Atrial septum defect: **5-10%**
   - Complex AVC defect: 2%
2. **Obstructive lesions**
   - Pulmonary stenosis: **7%**
   - Aortic stenosis: **5%**
   - Coarctation of aorta : **5%**



VSD



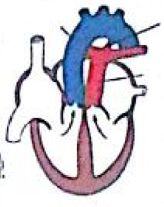
PDA



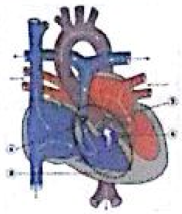
ASD

Cyanotic congenital heart lesions: 20%

1. **With increased pulmonary blood flow(lung plethora)**
   - TGA : Transposition of great arteries : **5%**
   - Truncus arteriosus
   - Single ventricle
2. **With decreased pulmonary blood flow (lung oligemia)**
   - Tetralogy of Fallot : **5%**
   - Pulmonary atresia
   - Tricuspid atresia



TGA



Fallot

Etiology: unknown

Genetic factors

1. Single gene or polygenic inheritance
2. Chromosomal abnormalities
   - Down syndrome→ VSD, ASD
   - Turner syndrome→ Coarctation of the aorta
   - Edwards' syndrome (trisomy 18): Complex lesions

Environmental factors

1. Maternal disorders
   - Congenital infection e.g. congenital rubella: pulmonary stenosis and PDA
   - Systemic lupus erythematosus: Complete heart block
   - Diabetes mellitus: incidence increased overall
2. Maternal drugs :
   - Warfarin therapy: Pulmonary valve stenosis, PDA
   - Fetal alcohol syndrome: ASD, VSD, tetralogy of Fallot

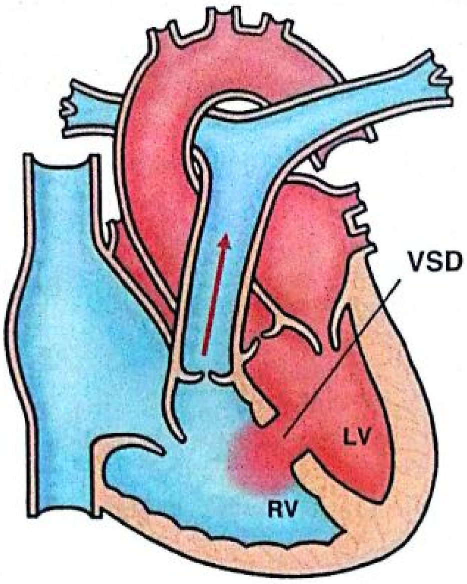
Ventricular septal defect

Incidence

The most common: 30 % of cases of congenital heart disease.

Pathology

1. Single defect in the **membranous part** of the septum: perimembrance (80%)
2. Single or multiple defects (Swiss cheese) in the **muscular part of the septum** (20%)



Hemodynamics

1. Blood is shunted from left ventricle to right ventricle during systole, no shunt occurs during diastole as the diastolic pressure in both ventricles is equal zero. The amount of shunted blood depends on the size of the defect.
2. Blood passes to the pulmonary artery causing elevation of pulmonary artery pressure
3. Blood passes to the lung → pulmonary congestion.
4. From the lung blood passes to the left side → dilatation of the left ventricle.
   In ventricular septal defect, firstly there is left ventricle enlargement secondary to left ventricle volume overload; right ventricle does not enlarge early, as the shunt occurs during systole while right ventricle is still in contraction

Clinical picture depends on the size of the defect (small or large)

Small defect < 3 mm

History: asymptomatic

Examination: pan systolic murmur over the left sternal border. Normal heart sound

Moderate and large defects: same or bigger than aortic valve diameter

History

1. Feeding difficulties: difficult breathing and excessive sweating during feeding (usually after the 2nd week)
2. Failure to thrive
3. Recurrent chest infection

× In moderate defects: symptoms tend to improve with time and may disappear because of actual or relative closure of the defect.

× In large defects: the baby may present with heart failure (tachycardia and tachypnea, with or without enlarged liver).

Examination

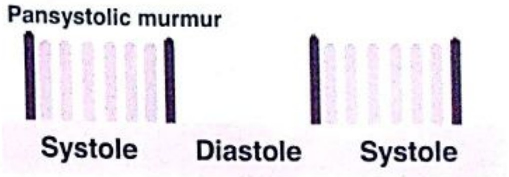
Inspection and palpation

1. Biventricular enlargement(mainly left ventricle) with hyperactive precordium
2. Systolic thrill over the left parasternal area.

Auscultation

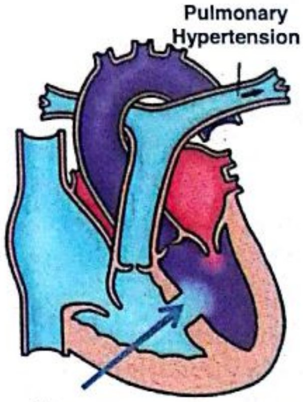
1. **Murmurs :** VSD
   Site: 3rd and 4th intercostal spaces at left parasternal line
   Area of maximum propagation: all over the precordium
   Character: harsh
   Timing: pansystolic (holosystolic)
2. **Sounds** : Accentuation of the pulmonary component of the second heart sound

Systolic thrill



Investigations

1. **X ray** (normal in small lesions).
   - Biventricular enlargement: left ventricle mainly
   - Pulmonary plethora (increased pulmonary vascular markings)
   - Pulmonary artery enlargement
2. **ECG**→ biventricular enlargement, left ventricle mainly.
3. **Echocardiography** to assess:
   - Defect (Site and size)
   - Direction of blood flow though it (color Doppler)
   - Chambers size
   - Cardiac function: degree of contractility
   - Pulmonary artery pressure



Eisenmenger syndrome

Complications: complications of left to right shunts:.

1. Recurrent chest infections
2. Congestive heart failure.
3. Infective endocarditis.
4. Shunt reversal: Eisenmenger syndrome in large defects
   Prolonged increase in pulmonary blood flow →pulmonary vasoconstriction , if not corrected → irreversible pulmonary obstruction with damage of capillary vascular bed → progressive increase in pulmonary artery and right ventricular pressure → right to left shunt → appearance of cyanosis in a previously acyanotic patient (it maybe as early as 6- 12 months)

Treatment

Medical

1. Small defect: Most of these lesions will close spontaneously.
2. In moderate defects if symptoms are prominent diuretics should be given.
3. Control of congestive heart failure (diuretics e.g. Furosemide and vasodilators e.g. captopril).
4. Protection against infective endocarditis by good dental hygiene and antibiotics prophylaxis before dental extraction or any operation where there will be bleeding.

Surgical

1. Moderate defects: avoid surgery (spontaneous closure may occur).
2. Large defects: surgical closure (at the age of 3-6 months).

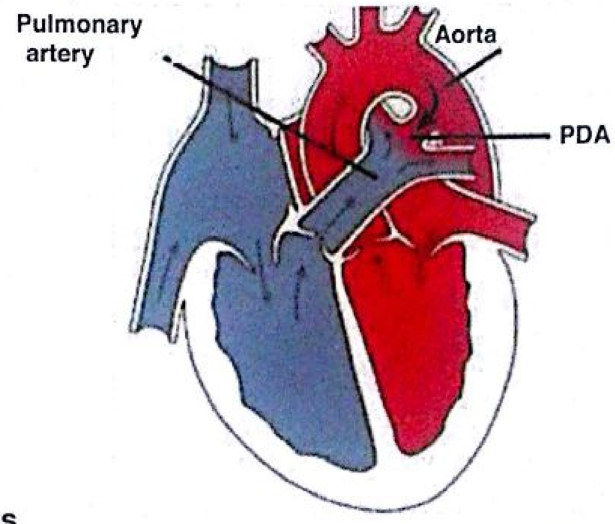
Persistent ductus arteriosus

Incidence

- 5-10% of all congenital heart disease.
- More common in females, premature infants and congenital rubella syndrome.

Pathology

- It is persistent communication between the descending thoracic aorta and the pulmonary artery.
- Fetal ductus arteriosus closes spontaneously after birth in response to oxygenated blood, in PDA it has failed to close by a month after birth due to a defect in the constrictor mechanism of the duct.



Hemodynamics

Pressure is higher in the aorta than in the pulmonary artery in systole and diastole blood is shunted continuously from aorta to pulmonary artery.

Clinical picture: depends on the size of the defect (small or large)

Small defect

History : asymptomatic
Examination: continuous systolic diastolic below the left clavicle. Normal heart sound

Moderate and large defects

History as VSD

General examination

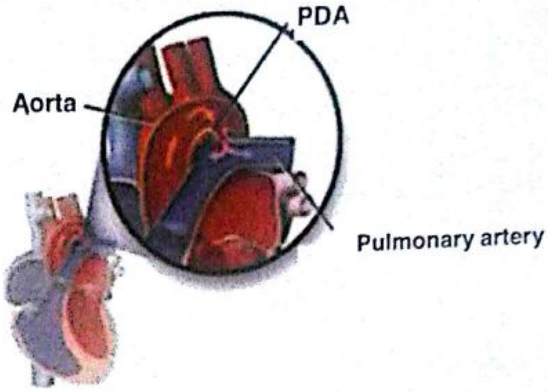
1. Pulse: large volume, water hammer pulse
2. Blood pressure: increased systolic pressure and low diastolic

Heart examination

Inspection and palpation: left ventricular dilatation (may be biventricular dilatation)

Auscultation

1. **Murmurs:** continuous systolic diastolic murmur (machinery) below the left clavicle
2. **Sounds** : accentuation of the pulmonary component of the second heart sound



Complications: the same like VSD

If Eisenmenger syndrome developed, right- to left ductal shunt results in cyanosis only in the lower half of the body (differential cyanosis)

Investigations: the same like VSD

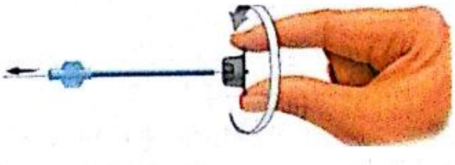
Treatment

Medical

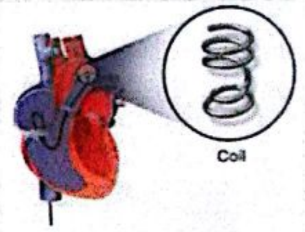
1. Indomethacin in preterm infant (ineffective in term infant)
2. Treatment of heart failure if present (diuretics e.g. Furosemide and after load reducing agents e.g. Captopril).
3. Protection against infective endocarditis by good dental hygiene and antibiotics prophylaxis before dental extraction or any operation where there will be bleeding.

Surgical

1. Closure with a coil or occlusion device introduced via a cardiac catheter at about 1 year old
2. Surgical closure: it is contraindicated if pulmonary vascular obstructive disease.



Occlusion device



Coil Closure of PDA

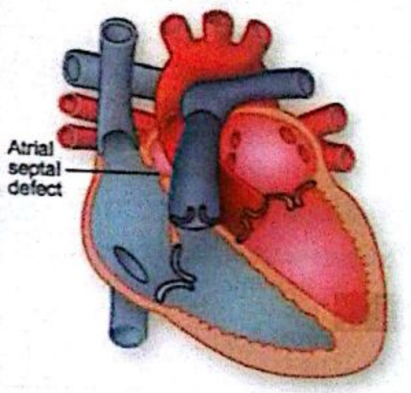
Atrial septal defect

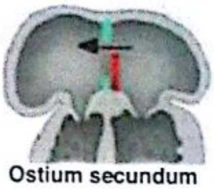
Incidence

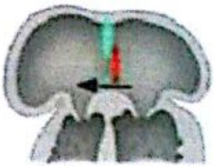
- 5-10% of all congenital heart disease.
- More common in females.

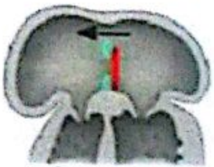
Pathology: according to the site, it is classified into 3 types

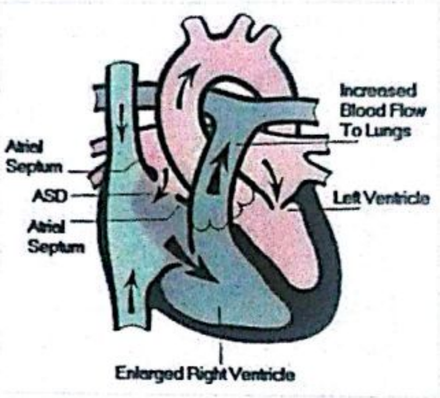
1. **Ostium secundum 80%** high ASD, in the region of fossa ovalis, less severe
2. **Ostium primum 20%** : low ASD , less common but more serious
    - In the lower part of the septum.
    - It is usually associated with incompetent atrioventricular valve.
    - May be part of atrioventricular canal defect.
3. **Sinus venosus defect:** near superior vena cava, associated with anomalies in pulmonary veins drainage




Ostium secundum


Ostium Primum


Sinus venosus



Hemodynamics

1. The pressure is higher in the left atrium than right atrium (right ventricle is less muscular and easier to fill with blood than the left ventricle).
2. Blood is shunted from the left to right atrium. The shunted blood passes to the right ventricle then pulmonary artery. The right side of the heart therefore takes the whole added burden of the shunt.

Clinical picture of ASD secundum

History

1. No symptoms usually
2. May present with complications(heart failure, arrhythmia and pulmonary hypertension) in the 3rd or 4th decades

Examination

1. **Inspection and palpation:** heart is normal or mild enlargement of the right ventricle
2. **Auscultation**
    - **Sounds:** fixed splitting of the second heart sound
    - **Murmurs:** no murmurs due to passage of blood across the ASD

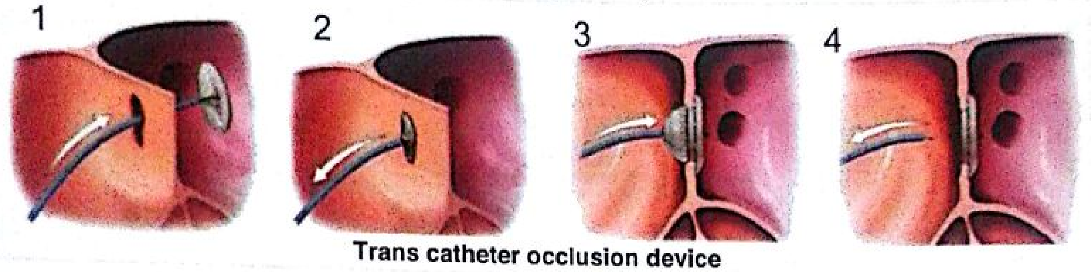
      Ejection soft systolic murmur over the pulmonary area (due increased blood flow over pulmonary valve).

Investigations

1. X ray: may show right ventricular dilatation, enlarged pulmonary artery and pulmonary plethora with moderate to large ASD.
2. ECG: right ventricular enlargement: partial right bundle branch block.
3. Echocardiography: enumerate diagnostic value of echocardiography.

Treatment

1. **Tran catheter closure by occlusive device.**
   At the age of 3 -5 years to prevent complications.
2. **Medical**
   - No treatment in small asymptomatic.
   - Treatment of heart failure if present (discuss).
   - Protection against infective endocarditis (discuss).



Trans catheter occlusion device

Atrioventricular septal defect

Incidence

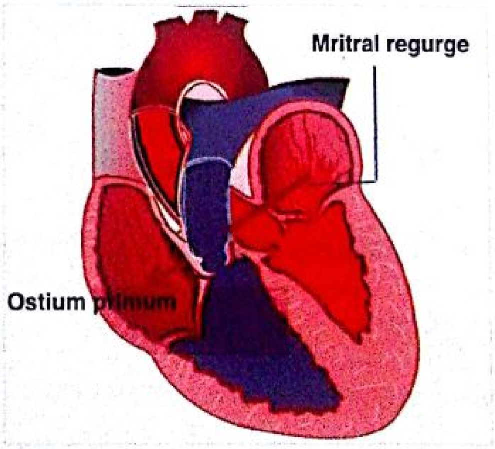
The most common with Down's syndrome

Pathology

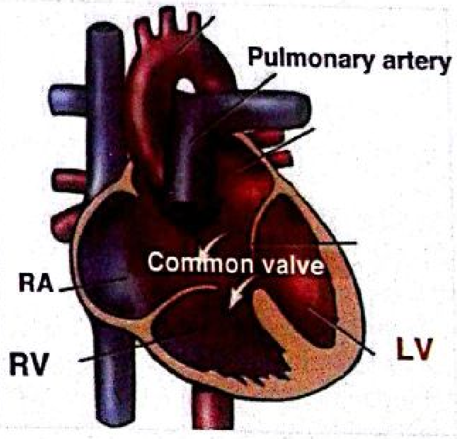
Defect in the middle of the heart with a single five-leaflet valve between the atria and ventricle which stretches across the entire atrioventricular junction and tends to leak.

Hemodynamics

1. Partial AVC : ostium primum with mitral regurge (MR)
   - Right side volume overload (like ASD)
   - Variable degree of left side volume overloads (depending on mitral regurge degree)
2. Complete AVC: ostium primum , VSD, MR
   Biventricular volume overload with early pulmonary hypertension



Partial AV canal



Complete AV canal

Clinical features

1. Presentation on antenatal ultrasound screening.
2. Congestive heart failure after 2-3 weeks of life depending on the size.
3. Mild cyanosis may be seen in large defects due to abnormal mixing of blood
4. Pansystolic murmur at the apex (atrioventricular valve regurge)

Treatment

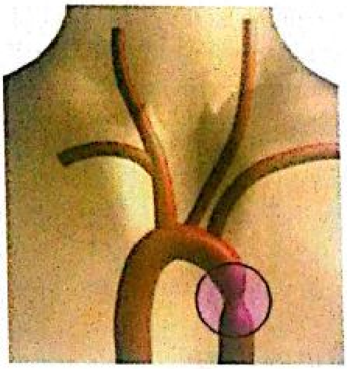
1. Treat heart failure medically
2. Surgical repair at 3 months of age to prevent pulmonary hypertension which develop early

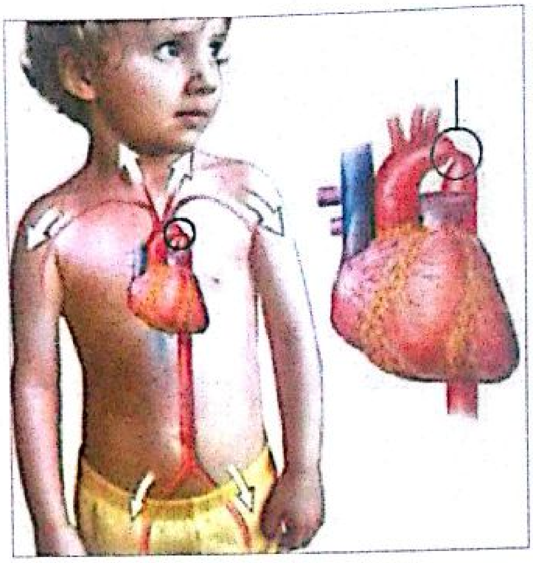
VSD	PDA	ASA
▪ **History** **Small defect** No symptoms **Moderate and large defect** . Feeding difficulties . Failure to thrive . Recurrent chest infection . Heart failure may occur	The same as VSD	- **In ostium secundum** : No symptoms - **in ostium primum** The same as VSD
▪ **Heart examination** **Ventricles enlargement** . Biventricular . Lt ventricle mainly	Left ventricle	Right ventricle (mild enlargement)
Thrill . Systolic thrill at Lt paraternal are	Systolic thrill at pulmonary area	
Auscultation **Sounds** (2nd heart sound) ↑ Pulmonary component	(2nd heart sound) ↑ Pulmonary component	(2nd heart sound) Fixed splitting
Murmurs . Pan systolic . Harsh . Left parasternal area	Continuous Machinery Below the left clavicle	Ejection systolic Soft Pulmonary area

Coarctation of the aorta

Pathology

Localized narrowing of the descending aorta usually occurs just below the origin of the left subclavian artery.
It is common in boys than girls
Common in Turner female





Hemodynamics

1. Pressure in the proximal part of the aorta is high→left ventricular hypertrophy and high blood pressure in the upper part of the body.
2. Pressure in the distal part of the aorta is low→low blood pressure in the lower part of the body.

Clinical picture

History

1. Usually asymptomatic in children
2. May be symptoms of hypertension e.g. headache
3. Presenting with complications of hypertension e.g. subarachnoid hemorrhage from Rupture of intracranial aneurysm, heart failure.

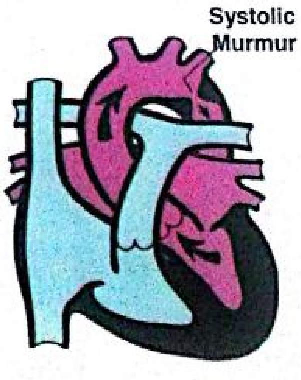
Examination

General examination

1. The femoral pulses are absent or weak and delayed (Radi- femoral delay due to blood passing the obstruction through collateral circulation between the branches of the subclavian artery, descending aorta and femoral artery). Routine palpation of femoral pulse is essential
2. Radial pulses are prominent.
3. Hypertension (in the right arm) during routine examination (routine measurement of blood pressure is important)
4. Marked blood pressure difference between the arms and legs.

Heart examination

1. Left ventricular hypertrophy.
2. Auscultation: ejection systolic murmur on upper left sternal border



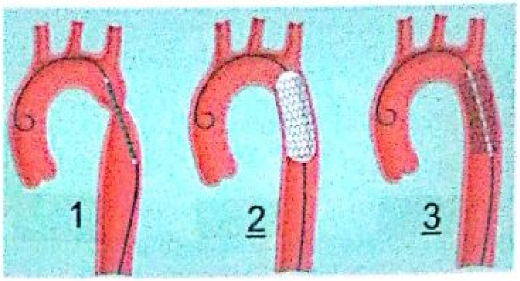
Investigations

1. X ray chest and ECG: left ventricular hypertrophy
   Rib notching may be seen in teenagers and adults (collateral vessels)
2. Echocardiography: left ventricular hypertrophy.
3. Doppler echocardiography is essential for diagnosis.

Treatment

1. Stent may be inserted at cardiac catheter (when the condition become severe)
2. Surgery: the narrowed segment of the aorta is excised and two ends are sewn together.
3. Balloon angioplasty.

Ballon angioplasty
With stent implantation



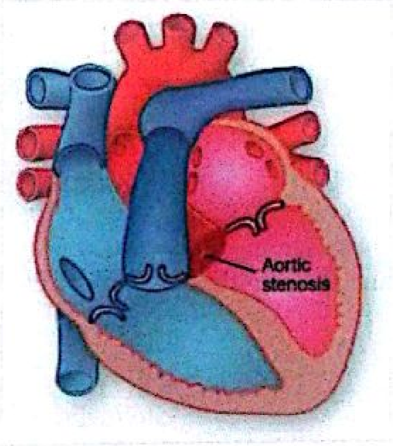
Congenital aortic stenosis

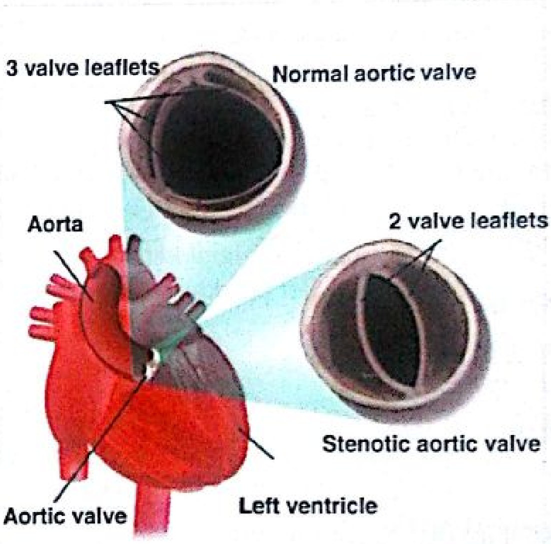
Pathology

Congenital aortic stenosis may be

- Valvular(bicuspid aortic valve usually fused at the edge) : the most common
- Subvalvular
- Supravalvular

It is often associated with mitral valve stenosis and coarctation of the aorta, and their presence should always be excluded.





Clinical picture

History

1. Mild cases: asymptomatic.
2. Severe cases
   - Low cardiac output symptoms: dizziness, fainting, syncope and anginal pain.
   - Heart failure and may be shock in infancy.
   - Bacterial endocarditis is a complication of aortic stenosis of any degree.

General examination

1. Pulse: small volume – slow rising
2. Systolic blood pressure: low

Heart examination

Inspection and palpation

- Left ventricular hypertrophy.
- Systolic thrill at the lower left sternal border, neck and over the carotids.

Auscultation

- **Murmurs**: Ejection systolic murmur at first aortic area (right 2nd intercostal space) radiating to the neck and apex.
- **Sounds**: delayed aortic second heart sound.

Investigations (the same items):

All will show left ventricular hypertrophy, normal or posts stenotic dilatation of the aorta

Treatment

In symptomatic cases and cases with pressure gradient across the aortic valve more than 50 mmHg

Techniques

1. Balloon dilatation
2. Open valvotomy in severe cases.
3. Aortic valve replacement should be avoided until children stop growing.

Coarctation of the aorta	Aortic stenosis	Pulmonary stenosis
▪ **History** . Hypertension . Presenting with complications . Left ventricle failure in neonates	. Asymptomatic . Lt ventricle failure .↓cardiac output symptoms	. Asymptomatic usually . Right ventricular failure Symptoms
▪ **General examination** . Absent femoral pulse . Prominent radial pulses . Blood pressure difference between the arms and legs.	. Pulse: small volume . Low systolic blood pressure	
▪ **Heart examination** **Ventricle enlargement** Left ventricle	Left ventricle	Right ventricle
Thrill No	Systolic thrill At the first aortic area, neck and carotids	Systolic thrill At the pulmonary area
Auscultation **Sounds**	2nd heart sound weak aortic component	2nd heart sound weak pulmonary component
Murmurs . Ejection . Harsh . Upper sternal border	Ejection Harsh First aortic area(2nd Rt space)	Ejection systolic Harsh Pulmonary area(2nd left space)

Tetralogy of Fallot

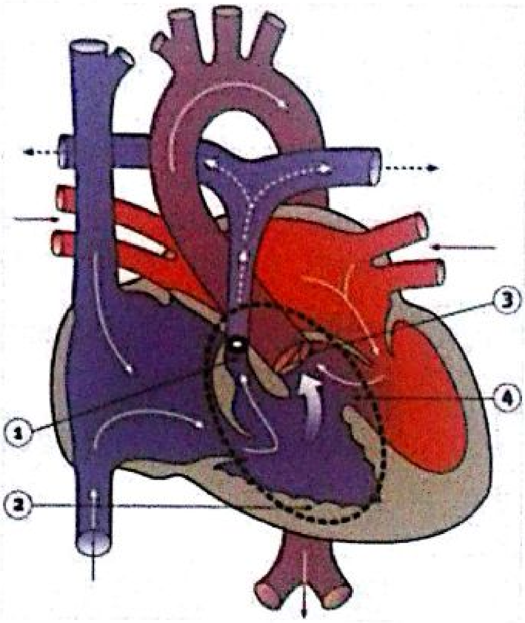
Incidence

The most common cyanotic congenital heart disease: 5% of all cases with congenital heart

Pathology

It includes

1. Pulmonary stenosis (infundibular ± valvular): right ventricular outflow tract obstruction.
2. Right ventricular hypertrophy (mild).
3. Overriding aorta.
4. VSD (large, high in the membranous part of the septum).



Hemodynamics

Systemic venous return to the right atrium and right ventricle is normal. When the right ventricle contracts, in presence of pulmonary stenosis blood is shunted into the overriding aorta→central cyanosis (aorta receives blood from both right and left ventricles).

Clinical picture

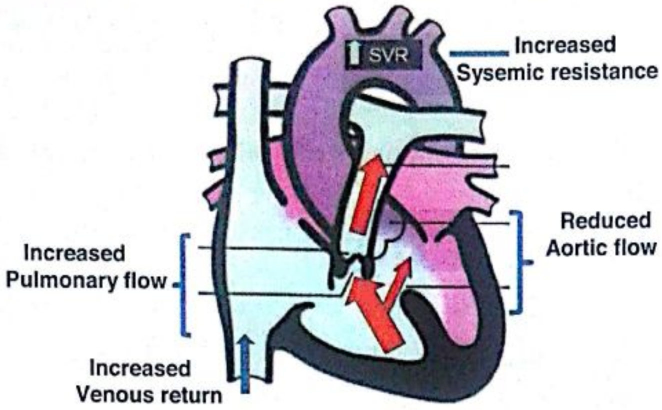
History

1. Cyanosis

- Cyanosis develops slowly as the child grows (3 months after birth)? Not at birth?
- Mild cases: cyanosis appears only during exertion and crying

2. Dyspnea: exertional dyspnea

3. **Squatting**: in children
   - Squatting improves oxygen saturation. Pressure on the femoral artery →increases systemic vascular resistance and aortic pressure → decreases right to left shunt, increasing pulmonary blood flow→ improve oxygen saturation.



Squatting position

4. **Hypercyanotic spells**
   - It is precipitated by stress, infections, and iron deficiency anemia
   - It is due to infundibular obstruction →further reduction in the pulmonary blood flow increase right to left shunt
   - It presents with: dyspnea, restlessness, deepening of cyanosis and may be convulsions.

Examination

General examination

1. Central cyanosis
2. Clubbing of the fingers and toes (not observed before 1-2 years)

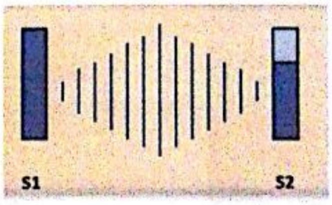
Heart examination

Inspection and palpation

1. Quite precordium, may be mild left parasternal pulsations due to mild right ventricular hypertrophy
2. Systolic thrill may be felt in the pulmonary area (50% of cases)

Auscultation

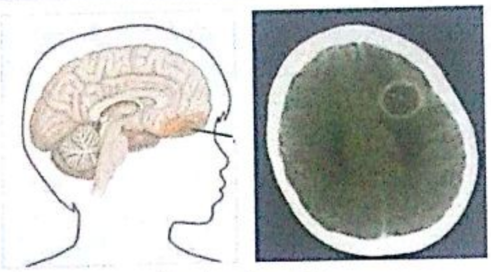
1. Ejection harsh systolic murmur heard at the pulmonary area (from day 1 of life). During a hypercyanotic spell, the murmur will be very short or inaudible.
2. No murmurs due to VSD because the pressure in both ventricles is equal.
3. Single second heart sound (the pulmonary component is too weak to be heard).



Ejection systolic

Complications

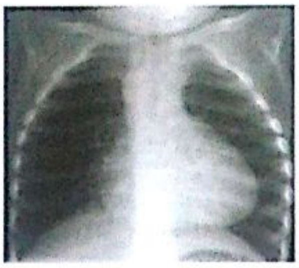
1. Hypercyanotic spells
2. Cerebral thrombosis (due to hyperviscosity from)
3. Brain abscess
4. Bacterial endocarditis
5. Iron deficiency anemia
6. Heart failure is very rare



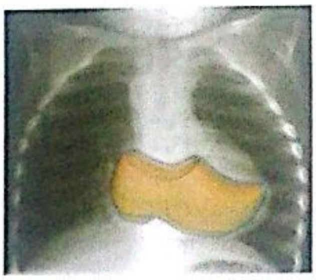
Brain abscess

Investigations

1. Blood picture: high hemoglobin concentration and hematocrit value but the red cells is microcytic and hypochromic
2. Blood gas analysis during hyper cyanotic spells : metabolic acidosis (acute hypoxia)
3. X ray: Coeur en sabot (boot shaped heart)



- Normal cardiothoracic ratio
- Acute cardophrenic angle
- Uplifted apex (Rt ventricle hypertrophy)
- Exaggerated waist (↓pulmonary artery size)
- Lung oligemia (↓pulmonary blood flow)



4. ECG: right ventricular hypertrophy.
5. Echocardiography
6. Cardiac catheterization: usually needed before surgery to show the detailed anatomy of the pulmonary arteries, which may be small or stenosed.

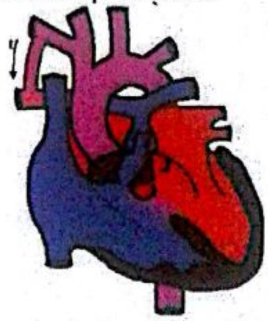
Treatment

Medical

1. **Treatment of hypercyanotic spells**

   Hypercyanotic spells are usually self-limiting and followed by a period of sleep. If prolonged beyond about 15 minutes, they require rapid treatment with:-
   - Squatting (knee chest position).
   - O2 therapy and IV fluids
   - Sedation and pain relief (Morphine may be needed)
   - Sodium bicarbonate to correct metabolic acidosis.
   - Propranolol or an alpha adrenoceptor agonist (Peripheral vasoconstrictor + relief pulmonary muscular obstruction).
   - If no improvement: mechanical ventilation
2. **Iron therapy for prevention of iron deficiency anemia.**
3. **Partial exchange transfusion in severe polycythemia.**

Blalock procedures



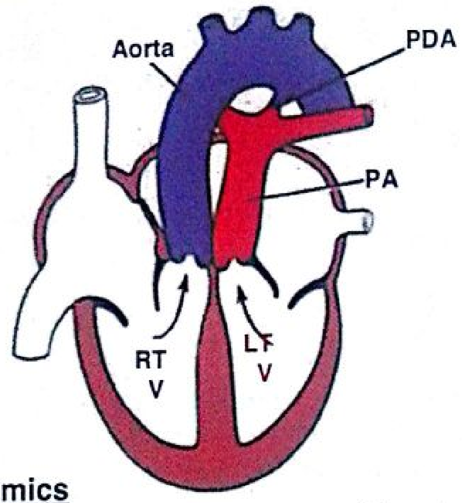
Surgical

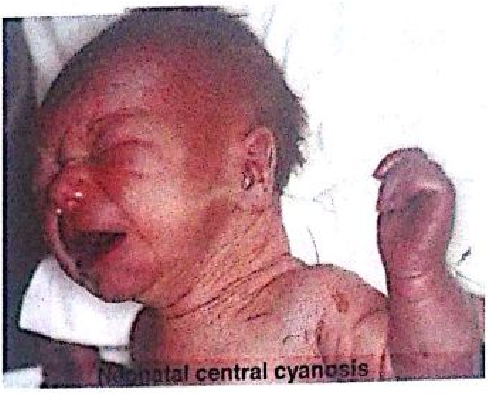
1. **Palliative shunt operation**: Modified Blalock procedure.
   - Anastomotic procedures (subclavian and left pulmonary artery) creating artificial ductus arteriosus.
   - It increases pulmonary blood flow in infants with very cyanosis until the baby is old enough for total correction.
2. **Total correction at about 6 months of age**

Transposition of Great Arteries

Pathology

The aorta arises from the right ventricle and the pulmonary artery from the left ventricle




Neonatal central cyanosis

Hemodynamics

1. Systemic venous blood returns to the right atrium and right ventricle and goes back to body again via the aorta, while pulmonary venous blood passes to the left atrium and left ventricle and back to the lung via pulmonary artery
2. The heart consists of 2 parallel circuits (systemic and pulmonary circulation).The 2 independent circulations allow survival because fortunately, there are a number of naturally occurring associated anomalies, e.g. VSD, ASD and PDA.

Clinical picture

History

1. Cyanosis: it may be marked, within the first few hours or days after birth (ductal closure → marked reduction in passage of oxygenated blood from aorta to pulmonary artery).
2. Difficult breathing
3. Recurrent chest infections

Examination

General examination

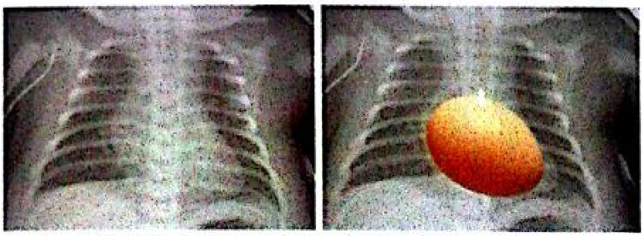
1. Delayed growth
2. Central cyanosis
3. Finger clubbing is present in the rare child presenting after the first year of life.

Heart examination

1. Murmurs: usually no murmur or short ejection systolic murmur (due to increased flow or stenosis within the left ventricle outflow (pulmonary artery)
2. The second heart sound is single (aorta lies anteriorly to the pulmonary arteryl)
3. Heart failure is common (but hypercyanotic spells do not occur)

Investigations

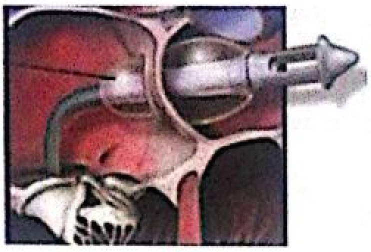
1. X ray: egg on side
2. ECG: right ventricular hypertrophy
3. Echocardiography
4. Cardiac catheterization

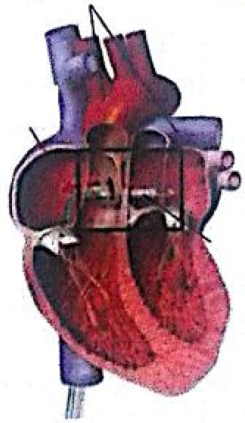

Acute cardiophrenic angle (right ventricle dilatation)
Right atrium dilatation
Narrow base

Treatment

1. Immediate prostaglandin E1 infusion to maintain ductus arteriosus patency
2. Urgent intervention at birth: Balloon atrial septostomy (Rashkind procedure) to maintain a large interatrial communication even when a VSD or PDA is present to allow good mixing of blood and improves cyanosis.
3. Definite repair in the first 3weeks of life by surgical correction (Arterial switch procedure)

Rashkind procedure





VSD	Fallot ↓ pulmonary blood flow	TGA ↑ pulmonary blood flow
▪ **History**		
. Feeding difficulties . Recurrent chest infection	. Cyanosis at 3 months old . Squatting and spells . Absent chest infections	. Cyanosis at birth . No spells, no squatting . Common chest infections
. Heart failure may occur	. Heart failure is rare	. Heart failure common
▪ **General examination**		
. Acyanotic	. Central cyanosis	. Central cyanosis
. Failure to thrive	. Clubbing	. clubbing (rare)
▪ **Heart examination**		
Ventricles enlargement		
Biventricular Lt ventricle mainly	Rt ventricle (mild)	Rt ventricle (marked)
Thrill		
Systolic thrill At Lt parasternal are	Systolic thrill At pulmonary area?	No
Auscultation		
Sounds		
2nd heart sound Accentuated Pulm.component	2nd heart sound Single	2nd heart sound Single
Murmurs		
. Pan systolic . Harsh . Left parasternal area	. Ejection systolic . Harsh . Pulmonary area	. Absent or soft ejection systolic murmur
▪ **X ray** : Cardiomegaly	Boot shaped heart	Egg on side

Complications of congenital heart disease in general

1. Complications of left to right shunt (VSD- PDA – ASD : ostium primum): see VSD
2. Complications of obstructive lesions
   Aortic coarctation: hypertension complications – heart failure – infective endocarditis
   Aortic stenosis: sudden death – heart failure – infective endocarditis
3. Special complications of Fallot tetralogy: see Fallot

Infective Endocarditis

Etiology

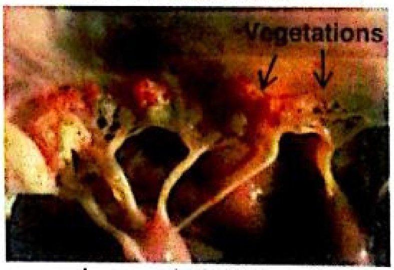
- **Organisms**
  1. **Gram positive** : alpha-hemolytic streptococci (Streptococcus viridans) is the commonest followed by Staphylococcus aureus, and coagulase-negative staphylococci,
     Enterococci are rare, but dangerous (highly resistant to antibiotics)
  2. **Gram negative: (HACEK organisms)** Haemophilus, Actinobacillus, Cardiobacterium, Eikenella, and Kingella species are particularly common in neonates and immunocompromised
  3. **Fungal** endocarditis is a severe disease with a poor prognosis and complications.

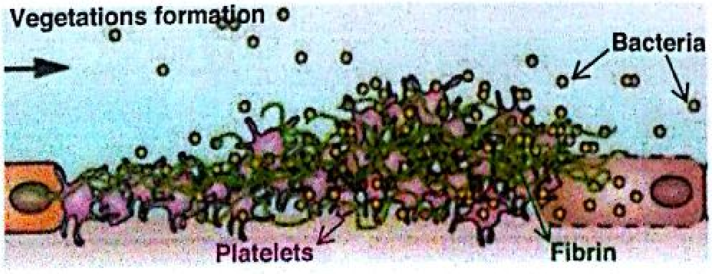
- **Predisposing factors**
  1. Tooth extraction
  2. Tonsillectomy or adenoidectomy
  3. Cardiac catheterization
  4. Central venous catheters (especially in neonates)

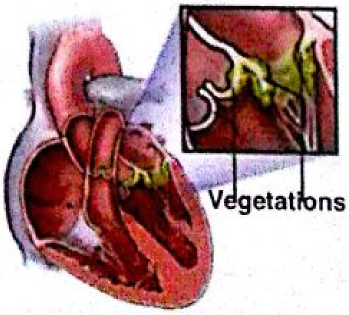
- **High-risk conditions**
  1. Cardiac lesions : in 75- 90% of cases
     - Congenital heart disease or rheumatic heart disease
     - Residual cardiac defect post-surgical
  2. Surgical systemic to pulmonary shunts and conduits
  3. Prosthetic valve.
  4. Previous episode of bacterial endocarditis
  5. Premature (prolonged hospitalization , frequent use of catheters, and (Frequent intervention; infective endocarditis can occur, even in normal heart)

Pathophysiology

1. **Endocardial damage by turbulence of blood flow or direct damage by catheters**
2. **Vegetation formation**
   - Platelets and fibrin adhere to the raw area in the endocardium (thrombus formation).
   - Bacteria and inflammatory cells adhere to and grow in these thrombi, forming infected vegetation.
3. **Vegetation fragmentation**→ systemic embolization
4. **Immune complex formation** → vasculitis and deposition on various endothelial surfaces







Diagnosis:

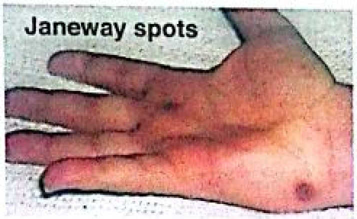
Modified Duke Criteria: 2 major OR, 1 major and 3 minor or 5 minor criteria

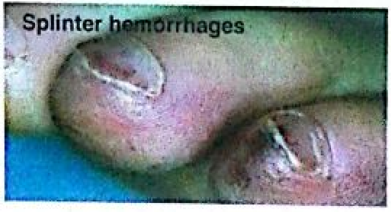
Major criteria

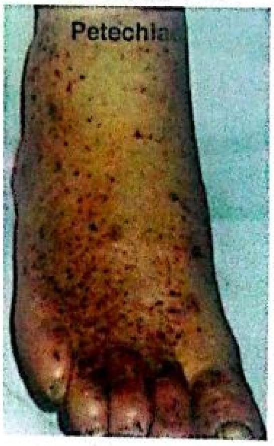
1. **Positive blood cultures.**
   - 2 or more separate cultures that grow an organism known to cause endocarditis
   - The most definitive laboratory tests for bacterial endocarditis are three blood cultures that grow an organism known to cause endocarditis
2. **Evidence of endocardial involvement**
   - New valvular regurgitations, may be rupture cusps→ Seagull murmur
   - Positive echocardiographic findings. e.g. vegetation on a valve

Minor criteria

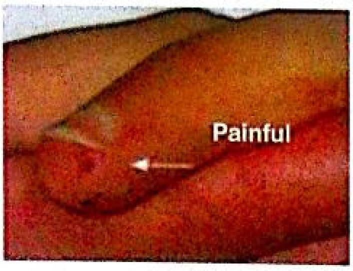
1. **Fever** with a temperature of more than 38°C.
   Infective endocarditis should be suspected in any cardiac lesion with unexplained fever
2. **Vascular phenomena**
   - **Eye:** subconjunctival hemorrhage
   - **Limbs**
     - Janeway lesions: painless erythematous lesions in the palm and soles
     - Petechiae
     - Splinter hemorrhage (hemorrhage under the nail bed)

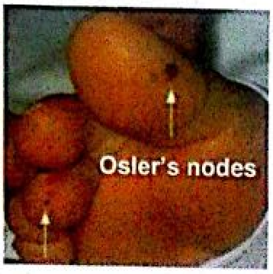






   - **Arterial emboli :**
     - **Limbs**: absent pulse from arterial emboli
     - **CNS** :strokes or intracranial hemorrhage
     - **Lung**: septic pulmonary infarcts
     - **Renal:** real infarction (hematuria)
3. **Immunologic phenomena: immune complex deposition**
   - Osler's nodes :painful nodes in palmer aspect of finger and toes
   - Roth spots (retinal hemorrhagic spots)
   - Glomerulonephritis
   - Splenomegaly
   - Positive rheumatoid factor.





4. **Positive blood culture findings** but not meeting major criteria above or serologic evidence of active infection with organism consistent with infective endocarditis
5. **Predisposition (congenital heart disease or history of IV drug use or).**

N.B : Other investigations in infective endocarditis : CBC : leukocytosis, ↑ESR, CRP

Treatment

1. **Medical:** immediate combined IV antibiotics to eradicate organisms in the vegetations.
   - **Penicillin-susceptible streptococcal endocarditis on native cardiac valves:**
     - Penicillin G for 4 weeks or penicillin or
     - Ceftriaxone combined with gentamicin for 2 weeks.
   - **Penicillin-resistant streptococcal endocarditis on native cardiac valves**
     - Ceftriaxone for 4 weeks, combined with gentamicin for the first 2 weeks.
     - Vancomycin can be used in patients who cannot tolerate penicillin or ceftriaxone.

   Penicillin-resistant streptococcal endocarditis on prosthetic **valves:** therapy is continued for 6 weeks

2. **Surgical Care**
   - **Absolute indications for surgery include:**
     - Progressive cardiac failure.
     - Perivalvular abscess,
     - Pseudomonas and fungal infection
     - Worsening valve obstruction,
   - **Relative indications**
     - Persistent bacteremia despite appropriate antibiotic therapy.
     - Candidal endocarditis, and vegetations larger than 10 mm

Prevention

1. Antibiotic prophylaxis prior to dental procedures: Amoxicillin at 50 mg/kg orally 30-60 minutes before the procedure.
2. In patients with a penicillin allergy, cephalexin at 50 mg/kg orally; clindamycin at 20 mg/kg orally, intravenously, or intramuscularly; azithromycin at 15 mg/kg orally
3. Good dental hygiene is the most important factor in the prophylaxis

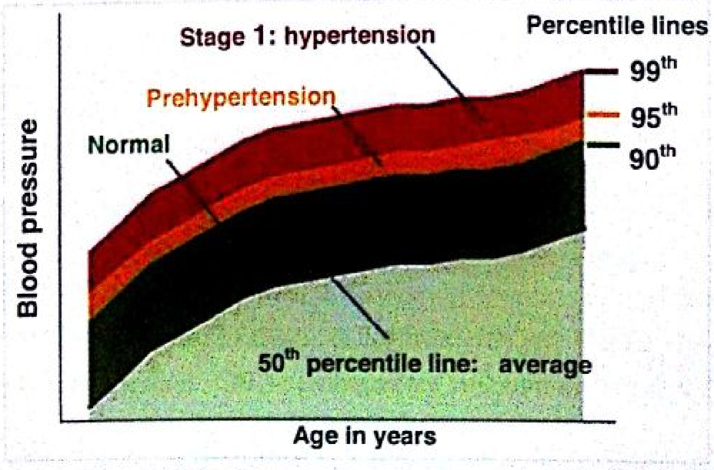
Pediatric Hypertension

Definition

Systolic or diastolic blood pressure ≥ 95th percentile for age, sex and height on ≥ 3 occasions

Stages of hypertension

- Normal < 90th
- Pre hypertension: blood pressure 90th percentile to <95th percentile
- Stage 1 hypertension: blood pressure 95th percentile to 99th percentile plus 5 mmHg
- Stage 2 hypertension: blood pressure > 99th percentile plus 5 mmHg plus 5 mmHg

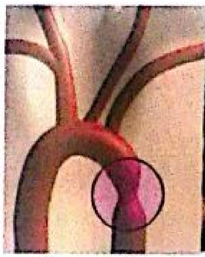


Measurement of blood pressure in pediatrics

1. Cuff width should cover about 70% of the upper arm's length
   Small cough: overestimates blood pressure, large cuff underestimates blood pressure
2. Cuff should encircles the arm completely
3. Blood pressure should be recorded in at least 3 separate office visits with 1 week apart
4. Blood pressure should be measured in both arms and a leg to rule out coarctation of the aorta.

Etiology

1. **Renal hypertension**
   - Renal parenchymal disease: nephritis, chronic renal failure and chronicpyelonephritis
   - Renovascular, e.g. renal artery stenosis.
   - Renal tumors.
2. **Coarctation of the aorta**
3. **Catecholamine excess** : Phaeochromocytoma
4. **Endocrine causes**
   - Cushing's syndrome
   - Corticosteroid therapy.
5. **Essential hypertension**
6. **Increased intracranial tension**



Coarctation

Cushing

Clinical picture

1. **Clinical picture of hypertension**
   - Headache, difficult initiating sleep and daytime tiredness (the 3 most common symptoms)
   - Failure to thrive and heart failure in infants.
2. **Clinical picture of the cause e.g.**
   - Nephritis: hematuria, oliguria and edema
   - Coarctation of the aorta: pulse disparity between upper and lower limb

Investigations: investigations of the causes

1. **Laboratory**
   - Blood picture, urine analysis, urine culture , urea and creatinine
   - Fasting glucose, lipids and hormone profiles
2. **Imaging**
   - Echocardiography
   - Ultrasound

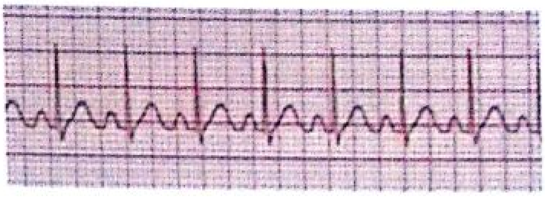
Treatment

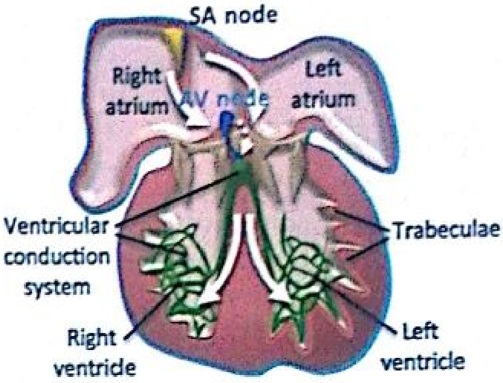
1. **Life style modifications : the initial treatment of choice**
2. **Antihypertensive drugs in**
   - Indications
     - Secondary hypertension
     - Poor response to lifestyle modification
     - Stage 2 hypertension
   - Commonly used drugs
     - Calcium channels blockers and ACE inhibitor

Rhythm Disorders

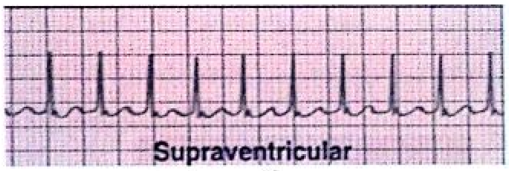
Tachyarrhythmia

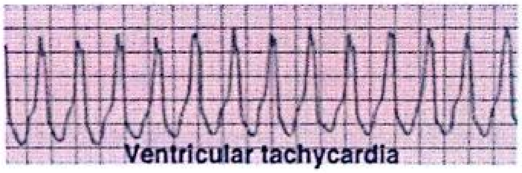
1. **Sinus tachycardia**
   - The heart rate is usually less than 200 beats/minute in sinus tachycardia.
   - It is 2ry to anxiety, fever, anemia, thyrotoxicosis, congestive heart failure and shock.
   - Treatment is of the cause.





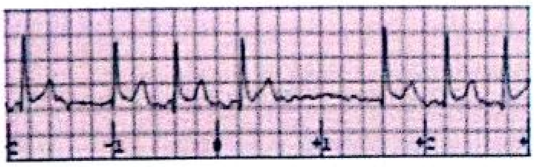
2. **Supraventricular tachycardia**
   - It is a narrow QRS tachycardia, originating above the ventricles (Atria or atrioventricular node) with an average rate of 240 +/- 40 per minute. P waves are usually absent.
   - It is paroxysmal with sudden onset and offset.
   - It is common in the first 3 months of life with a second peak at 8-10 years
   - **Treatment**
     - **Stable patients**: vagal maneuver is tried then drug therapy with adenosine.
     - **Unstable conscious patients:** adenosine, synchronized cardio-version.
     - **Unstable unconscious patients**: synchronized cardio-version





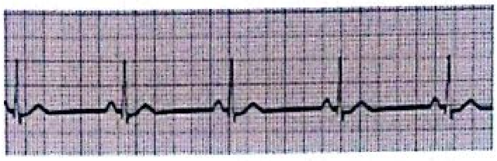
3. **Ventricular tachycardia:(VT)**
   - Regular wide QRS complex tachycardia with atrioventricular dissociation.
   - It is life threatening rhythm.
   - **Treatment:**
     - **Stable:** IV amiodarone or lidocaine.
     - **Unstable:** synchronized cardioversion

4. **Ventricular fibrillation**
   - It is a cardiac arrest rhythm with chaotic irregular waves.
   - Management is immediate DC shock once recognized followed by cardiopulmonary resuscitation .

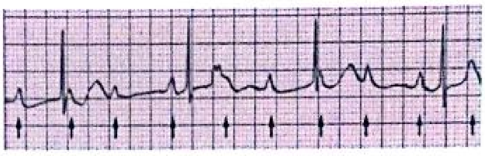


Bradyarryhthmia

1. **Sinus bradycardia**
   - A rate slower than 80 beats/minute in newborn infants and slower than 60 beats/minute in older children may be significant.
   - The most common cause is severe hypoxia which may end in cardiac arrest.
   - Others include hypothyroid and administration of drugs such as digitalis and β-adrenergic blocker.
   - Treatment is that of the cause.

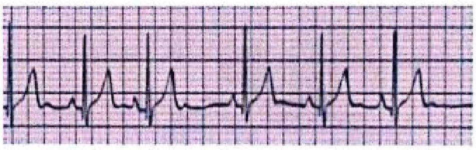


2. **Third degree AV block**
   - Common in infants born to mothers with SLE.
   - There is complete dissociation between P waves and QRS complexes.
   - Treatment : pace maker insertion

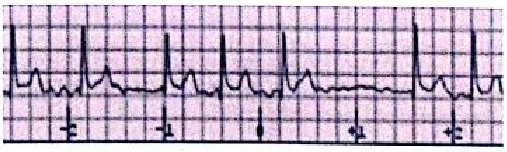


Irregular rhythm

1. **Sinus arrhythmia**
   - Normal variant requires no treatment.
   - Heart rate increases during inspiration and decreases during expiration



2. **Atrial fibrillation**
   - There is fast atrial rate 350 to 600 beats/minute with an irregular ventricular response.
   - It usually suggests a significant cardiac pathology and structural heart disease.
   - **Treatment**
     - **For recent atrial fibrillation more than 48 hours:**
       - Anticoagulation with warfarin for 2 to 3 weeks OR IV heparin 5-10 days
       - Then Cardio version is done, followed by oral warfarin .
     - **For chronic atrial fibrillation**.
       - Anticoagulation with warfarin is considered
       - Followed by rate control with drugs (propranolol, digoxine)



Upper Respiratory Tract Infections

- **Nasopharyngitis**
- **Otitis media**
- **Tonsillitis**
- **Laryngeal and tracheal infections**

Nasopharyngitis (common cold: Coryza)

Incidence

- The commonest infection in children.
- Usually involves sinuses and nasopharynx.

Etiology: usually viral infections

1. Viral: rhinoviruses, respiratory syncytial virus, coronaviruses and others
2. Bacterial: Haemophilus influenzae, staphylococci, pneumococci and others.

Clinical picture

1. **Fever:** Low grade fever
2. **Nasal symptoms**
   - Sudden onset of sneezing, then
   - Nasal discharge: watery in the beginning, then after few days it becomes mucoid.
   - Nasal obstruction→ irritability and may interfere with feeding.
3. **Pharyngeal congestion**

Complications

1. **Spread of infection**
   - To upper respiratory tract: otitis media, sinusitis.
   - To lower respiratory tract: bronchitis, bronchiolitis and bronchopneumonia.
2. **It may be**
   - Prodroma for measles or pertussis.
   - Precipitating factor for asthmatic attack in asthmatic patient.

× **Complications are suspected with:-**

- High fever (otitis media, sinusitis or bronchopneumonia).
- Significant cough (bronchitis).
- Persistent nasal discharge more than for days (sinusitis).

Treatment

1. Antipyretics e.g. Paracetamol and ibuprofen.
2. Nasal decongestants in infants with significant nasal obstruction.

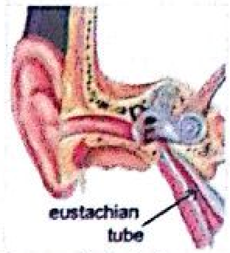
Acute Otitis Media

Incidence

- Common complication of nasopharyngitis in infancy and childhood (6 months to 6 years)? (In infants and young children Eustachian tube is short, horizontal and function poorly)

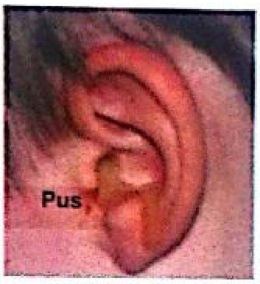
Etiology

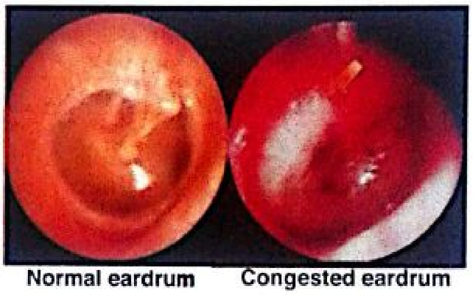
1. **Bacterial**
   - Streptococcus pneumonia(Pneumococci) and Haemophilus influenzae (Both accounts for 50% of cases)
   - Other organisms: staphylococci- streptococci-pseudomonas.
2. **Viral**
   - Rhinoviruses, respiratory syncytial virus



Clinical picture

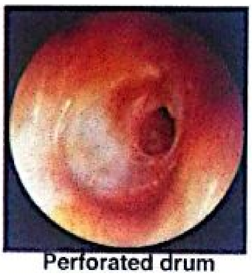
1. **Fever**: high, presents few days after the onset of nasopharyngitis.
2. **Ear manifestations**
   - Earache: irritability and continuous crying (otitis media should be excluded in any febrile patient with unexplained irritability).
   - Ear discharge may occur with drum perforation.
   - Ear examination (with otoscope): congested bulging eardrum with loss of normal light reflection.




Normal eardrum Congested eardrum

Complications

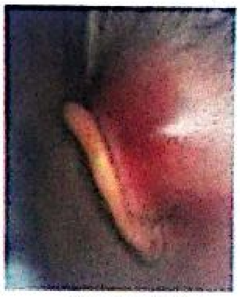
1. **Local (ear) complications**
   - Drum perforation.
   - Chronic Suppurative otitis media(hearing loss)
   - Chronic secretory otitis media (hearing loss).
   - Acute labyrinthitis (presents with ataxia).


Perforated drum

2. **Spread of infections**
   - **To the bone**
     - Mastoiditis (acute or chronic): swollen, painful and erythematous mastoid area.
     - Petrositis: infection of the pneumatized cells of temporal bone
   - **To the CNS : rare**
     - Meningitis, encephalitis, Cerebral thrombophlebitis
     - Acute facial paralysis.

Treatment: **80% of cases of otitis media resolve spontaneously**

1. Immediate oral broad spectrum antibiotic as amoxicillin or Amoxicillin claviulanic acid 45 mg/kg for 7-10 days.
2. Paracetamol for pain.

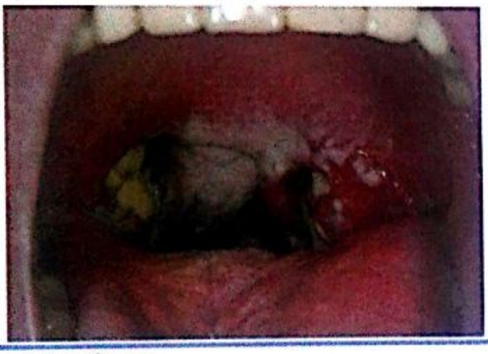
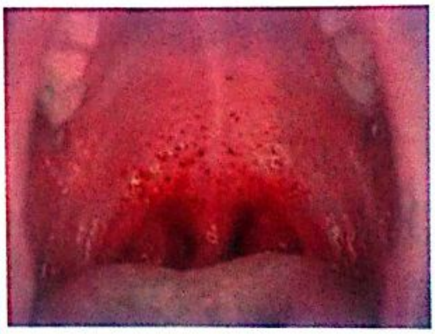

Mastoiditis

Acute Tonsillitis

Etiology

- Streptococcal pharyngitis and viral pharyngitis are the commonest causes.
- Other less common infections: infectious mononucleosis, Diphtheria.

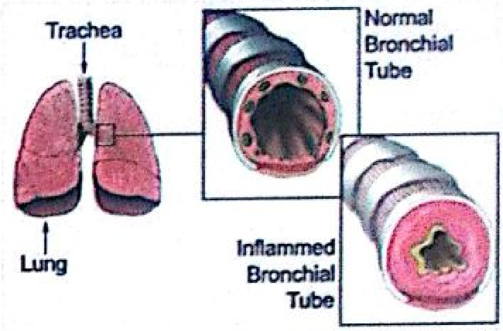
It is not possible to differentiate clinically between viral and bacterial tonsillitis, however the following may be of help.

Streptococcal pharyngitis	Viral pharyngitis
History 1- Fever . High fever may persist in severe cases up to one week. 2- Sore throat . Severe from the start →difficulty swallowing. 3- Others: Vomiting and abdominal pain.	. Mild to moderate fever. . Moderate, occurs 1-2 days after onset . Rhinitis, cough and conjunctivitis may help in differentiation.
Examination **1- Tonsils** . Diffuse redness of the tonsils and anterior pillars . Follicular (follicular pus) or membranous tonsillitis are common. **2- Tender cervical lymphadenopathy** 	. Mild erythema, small pharyngeal ulcers may occur. . Follicular tonsillitis is rare. 
Complications 1. **Spread**: peritonsillar abscess 2. **Late**: after 2 weeks Rheumatic fever Glomerulonephritis	
Treatment 1. Oral penicillin for at least 10 days Erythromycin in penicillin sensitive case 2. Paracetamol for fever	. Paracetamol for fever

- **Indications for tonsillectomy are controversial:**
  1. Recurrent tonsillitis.
  2. Peritonsillar abscess.
  3. Obstructive sleep apnea is absolute indications for tonsillectomy.

Lower Respiratory Tract Infections

- Acute bronchitis and Pertussis
- Acute bronchiolitis
- Pneumonia
- Pulmonary tuberculosis



Acute Bronchitis

Incidence

It is the most common cause of acute cough in children.

Etiology

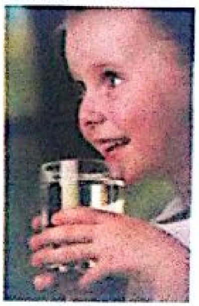
1. **Viral (the commonest cause)**
   - Non-specific: Rhinovirus, parainfluenza virus respiratory syncytial virus
   - Specific: measles
2. **Bacterial**
   - Non specific: Pneumococci, Streptococcie, Hemophilus influenza.
   - Specific: **Pertussis**

Clinical picture

Nasopharyngitis (sneezing and nasal discharge) for 3- 4 days, fever is mild (may be absent)

Cough: may persist for about 2 weeks

1. **Dry cough and chest discomfort the first few days.**
2. **Productive stage (the next few days)**
   - Cough: productive and less severe (purulent sputum with bacterial causes)
   - Chest examination: harsh vesicular breathing + Scattered expiratory rhonchi.
3. **Cough decreases in frequency** and severity over the next few days.



Treatment

Supportive treatment

1. Expectorants and or mucolytics - drinking water is the best expectorant.
2. Cough suppressants should be avoided except if cough is severe.

Specific treatment

1. Most cases are viral and recover spontaneously.
2. Broad spectrum antibiotics e.g. ampicillin 50 mg/kg/day for 7-10 days in bacterial infections (suspected with high fever, purulent sputum, prolonged cough)

Whooping Cough (Pertussis)

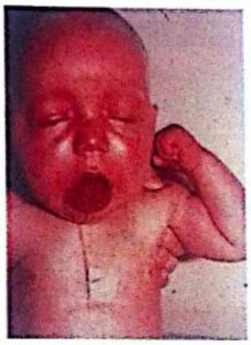
Etiology

Bordetella pertussis.

Clinical picture

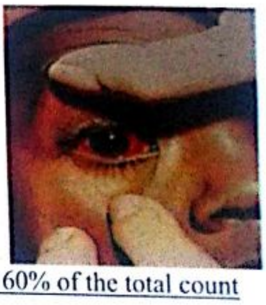
It starts after incubation period of 7 to 14 days

1. **Catarrhal stage:** nasopharyngitis and mild dry cough **1-2 weeks**
   It increases in frequency and severity and becomes more at night
2. **Paroxysmal stag:** Cough in attacks or paroxysms **2-4 weeks**
   - Paroxysmal attacks of severe spasmodic cough more at night.
   - The attack consists of a series of 5-10 forceful cough during one expiration → cyanosis and irritability.
   - The attack ends with inspiratory whoop, vomiting or cough of thick mucoid sputum.
3. **Convalescent stage:** decrease number and severity of paroxysms: **1-2 weeks**



Complications

1. **Respiratory**
   - Bronchopneumonia and pneumothorax a are the commonest complication in infants and young children.
   - Atelectasis (due to complete blocking of a bronchus by mucous plug)
   - Activation of latent TB focus
2. **Others**
   - Convulsions.
   - Hemorrhage (subconjunctival, epistaxis).



Investigations (confirm the clinical diagnosis)

1. Blood picture: leukocytosis (marked) above 20,0000, lymphocytosis 60% of the total count
2. Culture of nasopharyngeal swap

Treatment

1. Erythromycin 50mg/kg/day for 14 days (Once paroxysms of cough develop, it does not improve the symptoms, but it shortens the period of infectivity)

Pertussis like illness

With compulsory vaccination, pertussis becomes relatively uncommon, so organisms that produce pertussis like illness should be considered e.g. adenovirus infection. Lymphocytosis is also present but usually not marked as in pertussis

Acute Bronchiolitis

Definition

Acute viral illness of infancy resulting in inflammatory obstruction of the small airways

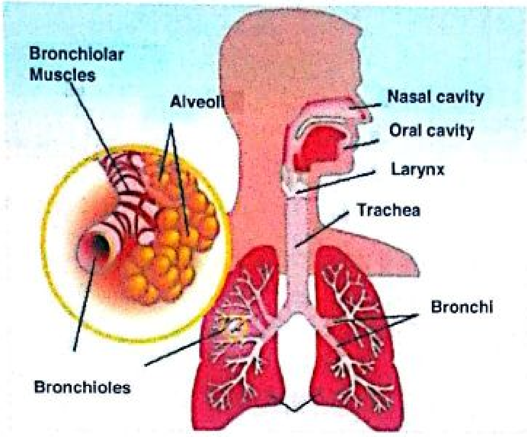
Incidence

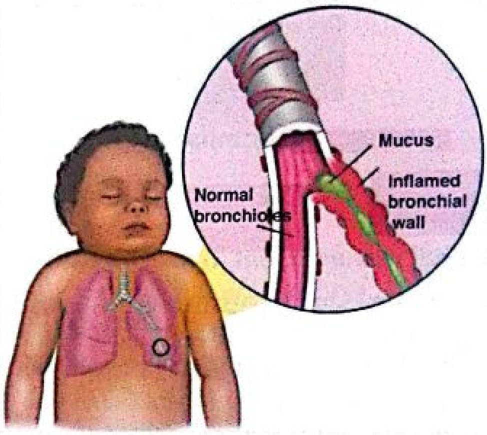
- First 2 year of life, peak incidence at 6 months of age
- The most common cause of respiratory distress and wheeze in infancy.

Etiology

The source of infection is usually a family member with minor respiratory illness

- Respiratory syncytial virus (the most common).
- Parainfluenza virus and adenoviruses in some cases.

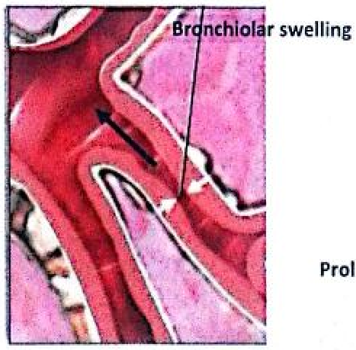




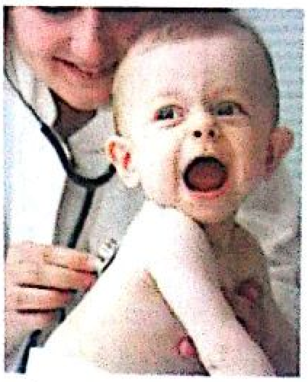
Clinical picture

History

1. Mild upper respiratory tract infection with nasal discharge and sneezing for few days
2. Then, the infant develops respiratory distress, wheezing, cough and irritability.



Prolonged expiration



Examination

Inspection

1. Manifestations of respiratory distress e.g. tachypnea and retractions (may be cyanosis in severe cases).
2. Hyperinflation of the chest

Percussion: hyperresonance.

Auscultation:

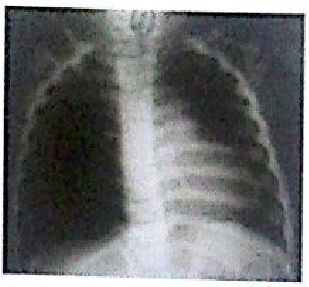
1. Harsh vesicular breathing with prolonged expiration.
2. Expiratory wheezes. Fine end inspiratory crackles (crepitations) may be present.

Rapid recovery occurs within few days, death in less than 1% from respiratory failure.

Differential diagnosis: causes of non-recurrent wheezes: P 116

Investigations

1. **Chest X ray**: hyperinflation of the lung due to small airway obstruction.
2. **Blood gas** in severe cases: lowered O2 tension and raised CO2.
3. **Pulse oximetry:** measures arterial oxygen saturation to decide the degree of hypoxia.
4. **Viral study:** respiratory syncytial virus antigen testing of nasopharyngeal secretions
5. **Blood picture, ESR and CRP** (viral infection parameters) discuss



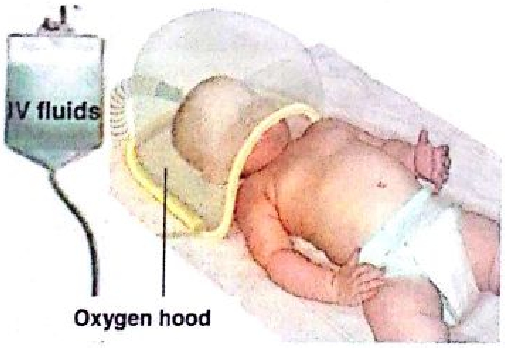
Hyper inflated chest

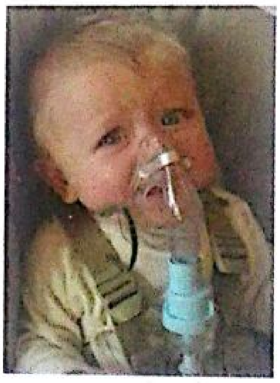
Pulse oximetry

Treatment

Hospital management in infants with moderate to severe respiratory distress

1. Humified O2 therapy to correct hypoxia
2. IV fluids (maintenance therapy) to prevent dehydration.
3. Nebulized salbutamol may be used with some benefits.
4. Corticosteroids are not beneficial.
5. Antiviral drugs are not necessary.
6. Assisted ventilation in cases with respiratory failure.





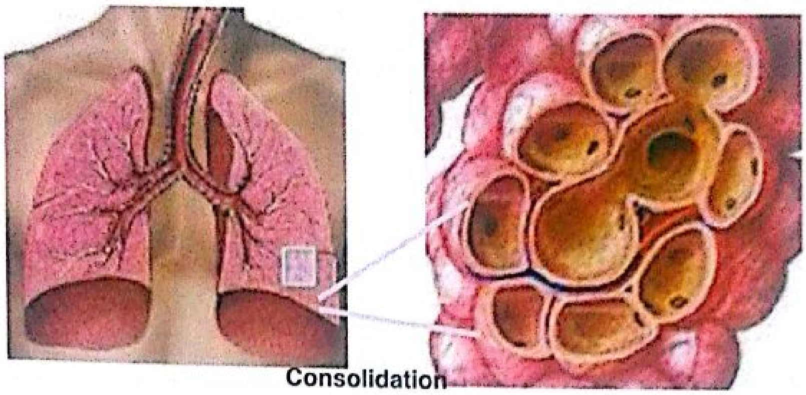
Home management in infants with minimal or mild respiratory distress

1. Careful feeding to avoid aspiration.
2. Close observation, increasing distress is an indication for hospitalization.
3. Drugs as cough medicine and bronchodilators are generally not helpful.

Pneumonia

Definition

Acute inflammatory consolidation of the lung parenchyma (alveoli, interstitial tissues). Usually there is associated involvement of small bronchi and bronchioles.



Etiology

Infectious pneumonia

1. **Bacterial**
   - Gram positive: Pneumococci (most common), Staphylococci, Streptococci.
   - Gram negative: Haemophilus Influenzae, Klebsiella, Pseudomonas.
   - T.B
2. **Mycoplasma and Chlamydia**
3. **Viral** : the most common cause in younger children
   - Respiratory syncytial virus
   - Adenovirus
4. **Parasitic**: Protozoal (pneumocystis carinii) in immunodeficiency.
5. **Fungal**: Histoplasmosis in immunodeficiency.

Non infectious pneumonia

1. Aspiration pneumonia (aspiration of amniotic contents, food, gastric acid or foreign body).
2. Hypostatic pneumonia

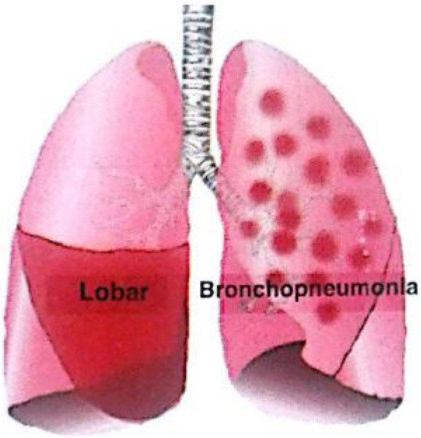
The organisms causing pneumonia vary according to the child's age

1. **Newborn** : B Streptococci - gram-negative enterococci (organism from the mother genitalia)
2. **Infants and young children**
   - Respiratory viruses especially Respiratory syncytial virus is the commonest.
   - Bacteria: streptococcus pneumonia, Haemophilus influenza and Chlamydia.
   - Staphylococci is less frequent but more serious.
4. **Children over 6 years**
   - Mycoplasma pneumoniae - streptococcus pneumoniae and Chlamydia.
   - TB pneumonia should be considered at all ages.

- **Staph. and klebsiella pneumonia are characterized by**
  1. Unilateral or bilateral asymmetrical pathology.
  2. Tendency to extensive necrosis with multiple areas of cavitations.
  3. Rapid progressive course with common complications.

Pathological types

1. **Lobar**
   - Unilateral affection of *one or more lobes*.
   - Etiology: bacterial, may be due to mycoplasma or TB.
2. **Bronchopneumonia**
   - Bilateral affection of *small areas* of both lungs.
   - Etiology: bacterial or viral.
3. **Interstitial**
   - Bilateral affection of *interstitial lung tissues*.
   - Etiology: mostly viral.



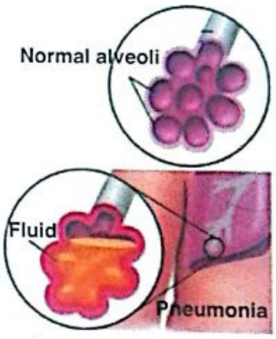
Clinical picture

History

1. **Respiratory symptoms**: pneumonia should be suspected in every case with respiratory distress, especially when there is fever and cough. It is usually preceded by upper respiratory tract viral infection (nasopharyngitis).
2. **General symptoms**(less prominent with viral pneumonia): fever, lethargy and poor feeding.
3. **Others**: abdominal pain (referred pain, caused by pleural irritation of the diaphragm) and chest pain (pleurisy) are common with bacterial infection.

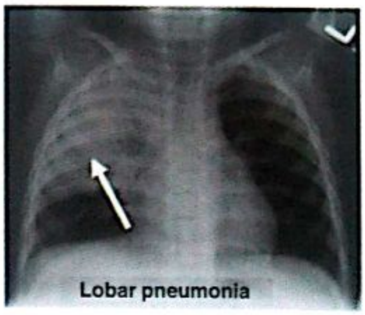
Examination

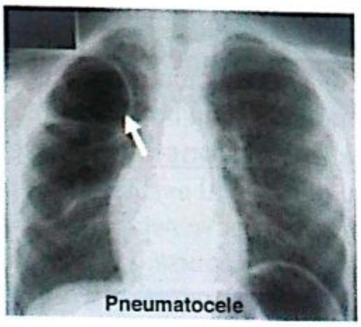
1. **Inspection** : manifestations of respiratory distress according to the severity
   - **Grade I** Tachypnea and working alae nasi
   - **Grade II** Intercostal and subcostal retractions
   - **Grade III** Expiratory grunting
   - **Grade VI** Cyanosis or altered consciousness in severe cases
2. **Percussion**
   - Dullness with pleural effusion (common with staphylococcal pneumonia)
   - Dullness over the affected lobe in lobar pneumonia
3. **Auscultation**
   - Fine consonating crepitations over the affected area are the main findings in bronchopneumonia
   - Bronchial breathing over the affected lobe or lobes in lobar pneumonia
   - Expiratory wheezes and chest hyperinflation with viral or mycoplasmal pneumonia).



Investigations

1. **Chest x ray**
   - Confirm the diagnosis but cannot differentiate between bacterial and viral pneumonia, except in streptococcus pneumonia that present with classic lobar consolidation.
   - The presence of pneumatoceles is characteristic for staphylococcal pneumonia.
   - If empyema is present → obliteration of the costophrenic angle

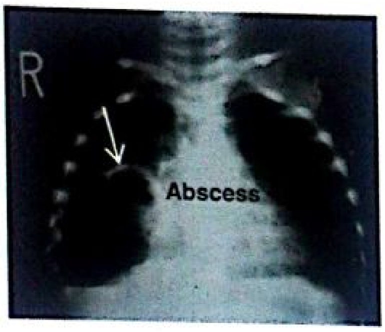

Lobar pneumonia

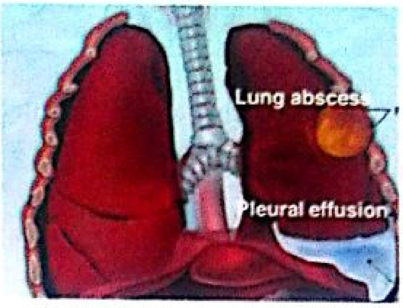

Pneumatocele

2. **Blood gas**: in severe cases lowered O2 tension and raised CO2.
3. **Complete blood count, ESR, CRP**: in bacterial pneumonia white cell count, ESR and CRP are elevated (normal or mild elevation in viral pneumonia).
4. **Culture and sensitivity test**: from nasopharyngeal aspirate or sputum

Complications

1. Pleural effusion: with bacterial pneumonia especially Staph.
2. Lung abscess with bacterial pneumonia especially Staph.
3. Respiratory failure: the most serious and common cause of death.
4. Myocarditis and acute heart failure in small infant with bacterial pneumonia.



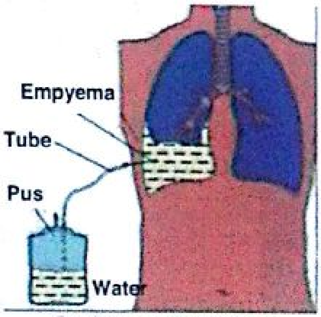


Remember: Diagnosis of pneumonia= clinical picture + investigations + complications

Treatment

Hospital management for severe pneumonia with respiratory distress

1. Humified O2 therapy to correct hypoxia
2. IV fluids (maintenance therapy) to prevent dehydration.
3. **Antibiotics**
   - The choice of antibiotic is determined by the child's age, severity of illness and chest X-ray findings, then modified according to the culture and sensitivity test
   - IV broad spectrum antibiotics to cover gram positive and negative for 7-10 days
     - Streptococcus pneumoniae or β streptococci : Cefotaxime or penicillin G
     - Staphylococcus aureus : Cloxacillin or Vancomycin
     - Gram negative : Cefotaxime with or without aminoglycoside e.g. gentamycin
   - Empyema if it develops, drainage must be done by underwater seal system
4. Assisted ventilation in cases with respiratory failure.



Drainage of empyema

Home management for older children with mild pneumonia without distress

Broad spectrum oral or better intramuscular antibiotics e.g., 3rd generation cephalosporin

Suppurative Lung Diseases

1. Bronchiectasis
2. Lung abscess
3. Empyema with bronchopleural fistula

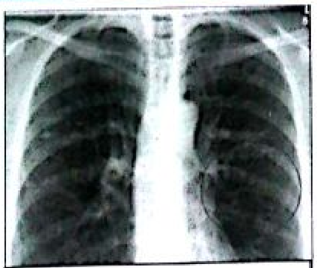
Bronchiectasis	Lung abscess
Definition Permanent dilatation of the medium sized bronchi with inflammatory destruction and accumulation of pus in bronchi.	Suppurative process resulting in destruction of lung parenchyma with formation of cavity containing pus.
Etiology 1. Acquired due to chronic infection and or obstruction: the same causes of recurrent wheeze (1- 6) 2. Congenital : rare	1. Aspiration of infected material or foreign body (primary lung abscess) 2. Secondary lung abscess ▪ Pneumonia e.g. staph.aureus, klebsiella ▪ Secondary to septic emboli e.g. from right sided infective endocarditis and septic thrombophlebitis. ▪ Amebic lung abscess(rare)

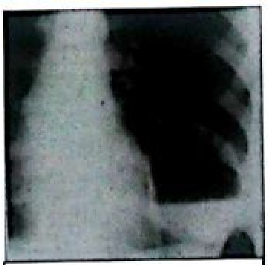
Clinical picture

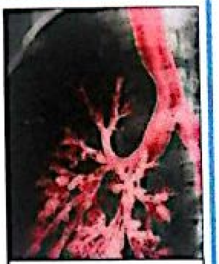
1. General manifestations of toxemia: fever, clubbing, anorexia and weight loss.
2. Respiratory manifestations
   . Cough with expectoration of excessive fetid sputum related to posture may be hemoptysis
   . Auscultation: bronchial breathing and crepitations

Investigations

1. X ray
2. CT
3. Sputum culture and sensitivity test
5. Bronchoscopy


Honey comb appearance Bronchiectasis

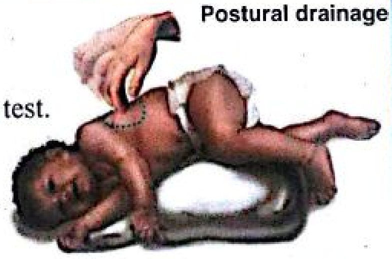

Cavity with air fluid level


Bronchography Bronchiectasi

Treatment

Medical

Postural drainage



1. Postural drainage.
2. Parenteral antibiotics according to culture and sensitivity test.
3. Physiotherapy.
4. Bronchoscopy if foreign body is suspected.

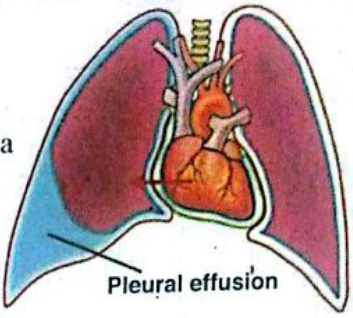
Surgical

1. Resection for localized bronchiectasis
2. In Lung abscess: resection of affected lobe in recurrent hemoptysis or repeated infection. Surgical drainage of a lung abscess is never indicated.

Empyema(purulent pleurisy)

Definition

Accumulation of pus in the pleural spaces



Etiology

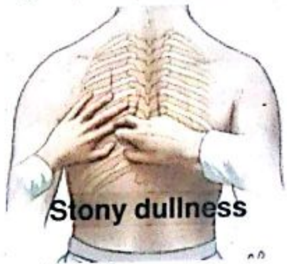
1. Secondary to lung disease:-
    - Pneumonia: Staphylococcus, Pneumococcal, H. influenza
    - Lung abscess or Bronchiectasis.
2. Mediastinal disease: mediastinitis.
3. Subdiaphragmatic disease: subphrenic abscess.
4. Contamination introduced from trauma or thoracic surgery.

Clinical picture

History

Acute onset usually with:

1. High fever
2. Pleuritic pain: chest pain increases with coughing or deep breathing and decreases by lying on the affected side.
3. Manifestations of respiratory distress e.g. tachypnea.

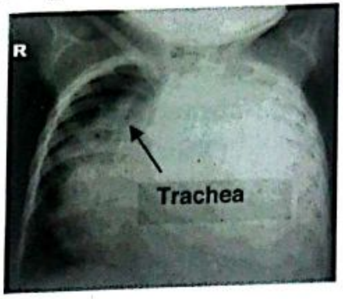


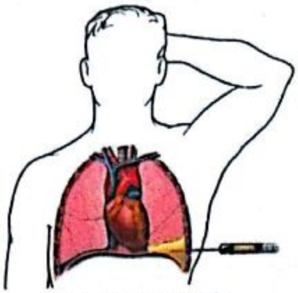
Examination depends on the amount of effusion

1. **Inspection:** limitation of movement of the affected side.
2. **Palpation**
   Mediastinal position
   - Small amount→ no shift.
   - Moderate amount → shift of heart apex and trachea to the opposite side.
3. **Percussion**: stony dullness
4. **Auscultation**: diminished breath sounds.

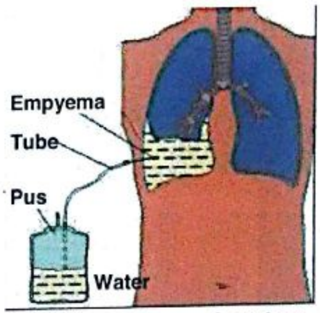
Investigations

1. **Imaging: x ray**
   Obliteration of the costophrenic angle by homogeneous opacity raising to the axilla and pushing the mediastinum to the opposite side.





Thoracocentesis



Under water seal system

2. **Laboratory**
   Thoracentesis: the collected fluid is examined (culture + sensitivity) to determine the causative organism.

Treatment

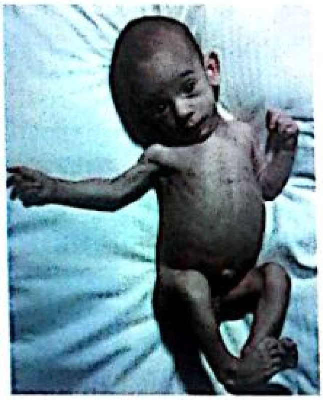
1. Treatment of the cause e.g. pneumonia by proper antibiotics
2. Management of effusion: immediate drainage by underwater seal system.

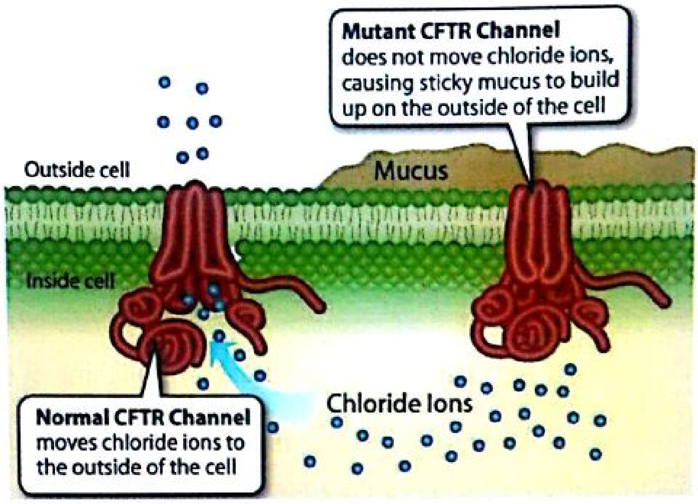
Cystic Fibrosis

Etiology

Autosomal recessive. Mutation in the cystic fibrosis trans membrane regulator (CFTR) gene (located on chromosome 7) → abnormal ion transport across the epithelial cells of the exocrine glands of the respiratory tract and pancreas results in increased viscosity of secretions.

Pathogenesis



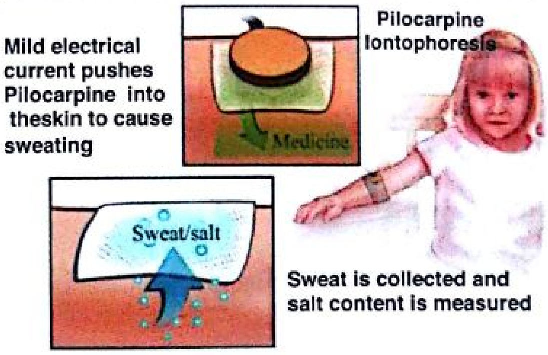

Mutant CFTR Channel
does not move chloride ions, causing sticky mucus to build up on the outside of the cell
Outside cell
Mucus
Inside cell
Chloride Ions
Normal CFTR Channel
moves chloride ions to the outside of the cell

Clinical features

	Hepatic	Respiratory	Intestinal and Others
At birth	Diagnosed by neonatal screening		
Newborn	Prolonged neonatal jaundice		. Meconium ileus → intestinal obstruction
Infants		Recurrent chest infections	. Failure to thrive
Young child	Chronic hepatitis	.Bronchiectasis+ abscess (due to chronic infection with Staph. H.influenza, and Pseudomonas) . Nasal polyps, sinusitis . Rectal prolapse	. Madigestion . Malabsorption due to Pancreatic exocrine deficiency (in 90% of cases) →Steatorrhea
Old child and adolescent	Cirrhosis Portal hypertension	. Pneumothorax . Recurrent hemoptysis . Allergic bronchopulmonary aspergillosis	.Distal Intestina obstruction . Diabetes (Non-insulin dependent usually) . Sterility in males

Investigations

1. Sweat chloride test: increased level of Na and chloride in the sweat (60-125mmol/L in cystic fibrosis (normal: 10-3mmol/L).
2. Low elastase in stool.
3. Chest X ray – CT


Mild electrical current pushes Pilocarpine into theskin to cause sweating
Pilocarpine Iontophoresis
Medicine
Sweat/salt
Sweat is collected and salt content is measured

Tuberculosis

Incidence

The incidence is increasing due to increasing HIV infection, and emergence of multi resistant strains

Etiology

Organism

- Mycobacterium tuberculosis

Mode of transmission

- Inhalation or ingestion
- Infection in children is due to prolonged close contact with an individual having untreated open TB. Children with TB rarely infect other children because of the presence of few bacilli and lack of force of their cough. The cause is significant exposure to an infected adult

Pathology

Primary infection

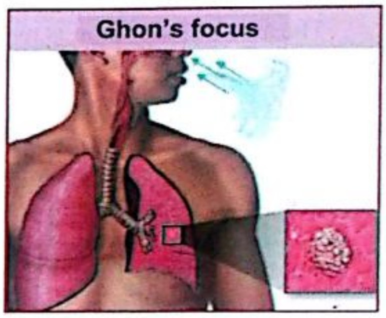
In non immune children with first contact with tubecle bacilli

- Usually the lung is the primary site (primary pulmonary tuberculosis)
- Other less commonly sites include intestine, tonsils and skin)

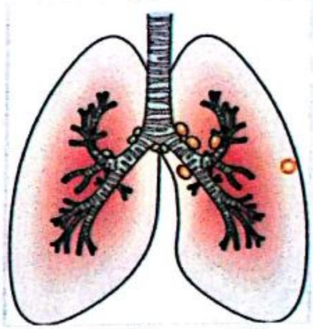
Primary pulmonary TB : primary pulmonary complex

- **Components**
  1. Ghon's focus
  2. TB lymphangitis
  3. TB hilar lymphadenitis

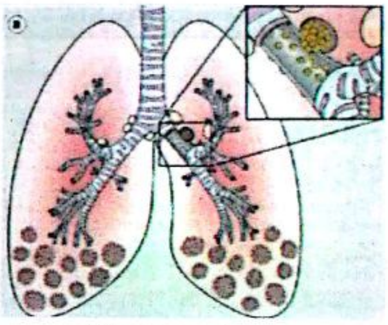
Ghon's focus



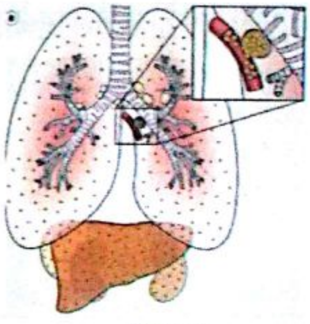
- **Fate**
  1. **Healing is the commonest result (with good immunity); → Asymptomatic**
     - Small (Ghon focus): complete fibrosis
     - Large focus: calcification (bacilli can persist in dormant form and cause disease many years later).
  2. **Spread (with low immunity):→ symptomatic**
     - Local spread → TB pneumonia, TB pleurisy and pleural effusion.
     - Bronchial spread → TB bronchopneumonia.
       × Bronchial obstruction by enlarged lymph nodes may occur.
     - Blood spread
       - Miliary tuberculosis: large number of bacilli invades the blood.
       - Isolated organ tuberculosis: moderate number of bacilli invades the blood.



Primary pulmonary TB



TB pneumonia



Miliary

Clinical picture of pulmonary TB

History

1. TB toxemia: anorexia, night fever, night sweat and weight loss.
2. Chronic cough (the main symptom). Sputum may be mucoid, purulent or blood tinged
3. Chest pain, and dyspnea may occur.
4. Localized or persistent wheezes (due to compression of the trachea and bronchi by lymph nodes)

Examination

1. In pneumonic lesion: crepitations and bronchial breathing.
2. In pleural effusion: diminished air entry and dullness.
3. Bronchial compression by lymph nodes: expiratory wheezes
4. In fibrosis: deviation of the trachea and mediastinum to the same side occurs

Any chest symptom or radiological chest sign with poor response to routine treatment should be investigated considering TB.

Investigation

Tuberculin test: Monteux test

- **Administration**
  - PPD: purified protein derivative , 0.1 ml intradermal in the forearm (flexor surface)
- **Interpretation: After 48-72 hours**

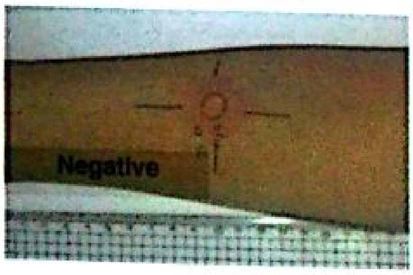
  If any local reaction appears, measure the area of induration not erythema.

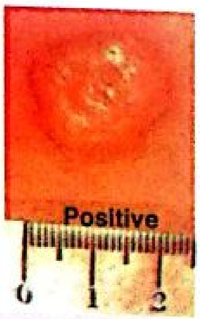
  The area of induration is measured in mms in the longitudinal as well as the transverse diameters and the mean reading is recorded

  1. **Negative reaction**: **No reaction or induration less than 5 mm in diameter**

     Either: no TB infection: suspected disease is not TB infection (good negative test)

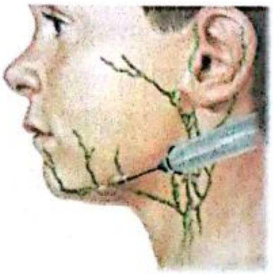
     OR: false negative reaction: TB infection is present but does not show itself due to:
     - Testing in the pre-allergic state (after infection but before the development of sensitization which takes 6-8 weeks)
     - Giving tuberculin subcutaneous instead of intradermal; or giving inactive tuberculin
     - Immunosuppression: factors interfering with lymphocyte activation:-
       - Fulminant T.B
       - Corticosteroids or immunosuppressives or cell mediated immune deficiency
       - Severe malnutrition or chronic diseases with cachexia.
       - Recent viral infection (especially measles and mumps) or vaccinations.
  2. **Positive reaction**: **Induration 10 mm or more:** TB infection or B.C.G vaccination
     - BCG : the reaction never exceeds 15 mm induration
     - TB infection is considered in
       - Positive reaction in a child less than 5 years who is not BCG vaccinated
       - Strongly positive reaction over 15 mm in previously vaccinated child
  3. **Doubtful reaction**: **Induration 6- 9 mm, test should be repeated.**

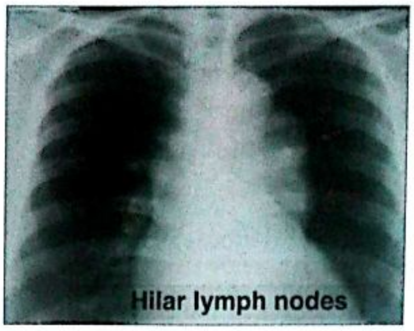


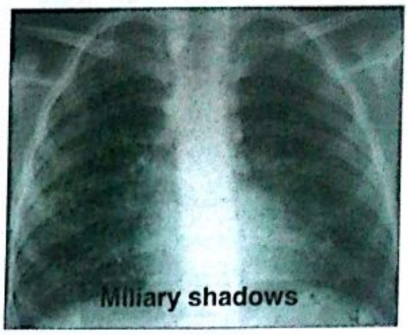


Other investigations

1. CBC (anemia), Erythrocyte sedimentation rate (elevated), C reactive protein (positive)
2. Isolation of the organism from sputum, gastric aspirate and stomach wash:- Direct Z.N stain → (acid fast organism).
   Culture on Lowenstein Jensen medium (4 weeks), better BACTEC culture (only10 days)
3. ELISA (Enzyme linked immune sorbent assay) to detect specific antibodies to TB bacilli.
4. PCR (polymerase chain reaction) to identify the DNA of the TB organism.
5. CSF: TB meningitis: (↑ protein, ↓ sugar, ↑ lymphocytes).
6. Biopsy: lymph node, skin, pleura.
7. Chest X and CT chest: any lesion e.g. mediastinal shadow, miliary shadows.







Prevention

General and community measures

1. Socioeconomic development: increased income, good housing.
2. Sanitary environment: better aeration in crowded places and schools.
3. Food sanitation: elimination of TB from cattle and milk pasteurization.
4. Diagnosis and treatment of cases especially those working in schools or hospitals.

Specific prevention

1. **BCG vaccination**: (discuss in details from vaccination)
2. **Chemoprophylaxis in tuberculous contacts**: isoniazide 15 mg/kg day for 6 months for children with prolonged contact with open (infective) case of TB

Treatment

Principles of therapy

Combined drug therapy: 2 or 3 drugs of the first line drugs for at least 6- 9 months.

Drugs

1. **First line drugs are** (the main side effect is hepatotoxicity)
   Isoniazid: 10- 20 mg/kg/ day orally.
   Rifampicin: 10-20 mg /kg/ day orally.
   Pyrazinamide: 20-40mg /kg day orally.

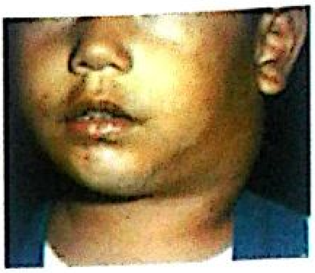
2. **Second line drugs are**
   Ethionamide: 10-20 mg/kg orally.
   Ethambutol : 10-20 mg /kg/day orally
   Streptomycin : 20-40 mg/kg/day **I.M** (side effects :-ototoxicity and nephrotoxicity)

In the first 2 months: isoniazid + rifampicin+ pyrazinamide
In the following 4 months: isoniazid + rifampicin

Indications of corticosteroids in TB

1. Allergy to anti TB drugs
2. After surgical removal of cervical TB lymph nodes to avoid fibrous tissue formation
3. Adrenal gland damage in miliary TB
4. Exudative form of TB: pleurisy, serous pericarditis, ascitic type of TB peritonitis
5. Endobronchial TB after removal of the glands to avoid postoperative stricture

Extra pulmonary TB

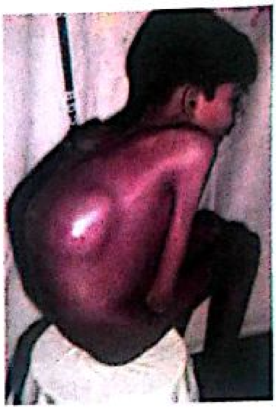


1. TB lymphadenitis

- Cervical lymph nodes are most commonly affected.
- Initially lymph nodes are discrete, mobile and not tender
- Then, nodes are matted and adherent to the deep
- structures with cold abscess formation

2. Skeletal TB

- **TB of the spine (Pott's disease)**
  - Lower thoracic vertebra followed by lumbar, then cervical regions is affected.
  - It affects the body of one or more vertebrae resulting in bone destruction
  - Pain, kyphosis and compression paraplegia
  - X ray: rarefaction and destruction of the vertebrae.



- **TB arthritis**
  - Large joints (hip, ankle, knee and elbow).
  - Pain with limitation of movement
  - X ray: rarefaction and destruction of the bone near the the affected joint.

3. Abdominal TB

- **TB enteritis (primary or secondary)**
  - Chronic diarrhea with tenesmus and bleeding.
  - Stools are white and greasy (malabsorption).
- **TB peritonitis** : caused by direct extension from mesenteric lymph nodes
  - Ascitic :- fluid with high protein content and lymphocytes
  - Caseous:- doughy sensation of the abdomen.
  - Adhesive:-Loops of intestine are glued together by fibrinous adhesions.
  - Encysted :-small effusion and caseous masses are encysted between adherent loops
- **Tuberculous mesentric lymphadenitis (Tabes mesentrica)**
  - Enlarged matted glands palpable in the right iliac fossa
- **Urogenital TB**
  - Renal tuberculosis: results from hematogenous spread of TB bacilli.
  - Bacilli are released in urine and may spread to the renal pelvis, ureters, bladder,
  - Urine examination reveals sterile pyuria but culture may be positive

4. TB of the CNS

- **TB meningitis**
  - Hematogenous in origin or with miliary TB.
  - Headache, irritability, disorientation (due to increased intracranial tension).
  - Convulsions and focal neurological deficits.
  - CSF: increased protein and lymphocytes, decreased glucose and chloride
- **Tubeculoma**
  - Caseous lesion large enough to act as space occupying lesion

5. Other types

- **TB pericarditis:** through lymphatic spread- diagnosed by echocardiography.
- **TB of the skin** (lupus vulgaris)
- **TB of the eye and ear** (chronic otitis media and mastoiditis)

Bronchial Asthma

Definition

Chronic inflammatory disease of the airways with hyperreactivity to a variety of stimuli and high degree of reversibility of the obstructive process

Incidence

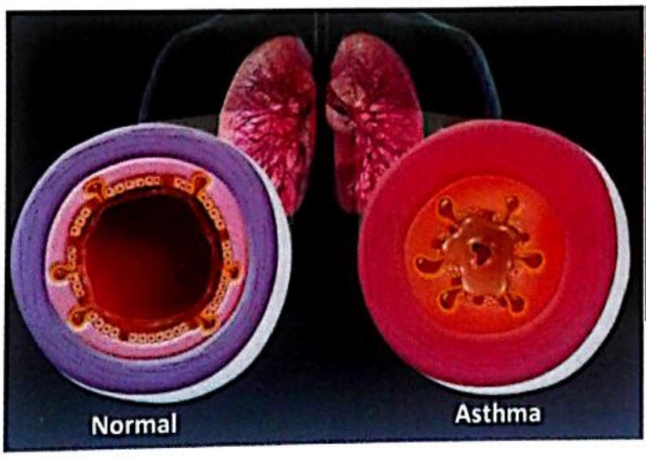
- The most common chronic disease of childhood. 10% of school children and much higher incidence in preschool children.
- Before puberty: boys to girl's incidence are 2:1, later on the sex incidence is equal.

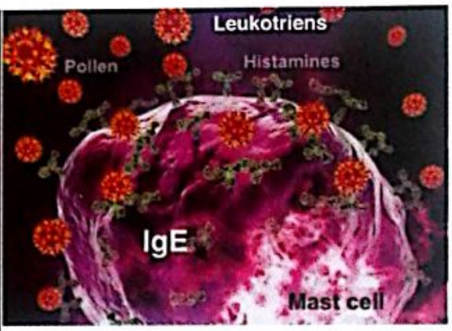
Etiology

- Multifactorial inheritance (genetic predisposition + triggering environmental factors)

Pathophysiology

1. Asthma results in chronic inflammation of the airways.
2. Inflammatory cells (lymphocytes, mast cells, eosinophil and neutrophils) and chemical mediators (leukotrienes, histamine and chemotactic factors) mediate the underlying inflammation found in the airways.
3. Inflammation results in bronchospasm, hypersecretion of mucous, submucosal edema and inflammatory cell infiltration
4. Inflammation leads to airway hyperresponsiveness (hyperreactivity) which is the tendency for the airways to constrict in response to allergens, viral infections, exercise and irritants.
5. Acute asthmatic episode occur when the hyperreactive airwas is exposed to a triggering factor (asthma triggers)





Cells

- Lymphocytes
- Mast cells
- Eosinophil

+

- Leukotriens
- Histamin
- Chemotactic factors

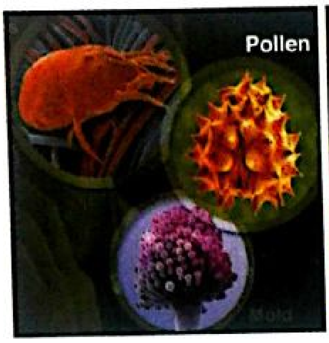
Mediators

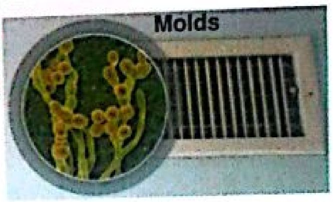
- Mucosa: hypersecretion of mucus
- Submucosa: edema and cell infiltration
- Muscle : bronchospasm

Airway inflammation

6. Asthma triggers include

- **Atopic asthma**
  The child has an inherited predisposition to allergy and sensitive to many foreign proteins which are not usually antigenic, with tendency to develop high level of IgE against it
  - Antigen: house dust mites, grass pollens, molds, vegetable protein.
  - Immunoglobulin: IgE formed in response to Ag and fixed on Mast Cells.
  - Reaction: type 1 hypersensitivity reaction.
    On re-exposure there is degranulation of mast cells and release of chemical mediators. Mast cell may release chemical mediators following nonspecific stimulation.





- **Viral respiratory infection**; respiratory syncytial virus.
- **Exercise or cold air.**
- **Excitement and upset.**
- **Drugs e.g. aspirin and non-steroidal anti-inflammatory drugs.**
- **Chemical: e.g. paints and domestic aerosols.**

Diagnosis of bronchial asthma

1. Diagnosis of the attach as bronchial asthma

- **History**
- **Examination**
- **Investigations**
- **Differential diagnosis**

2. Full diagnosis shouold include

- **Assessement of acute attach severity**
  (Mild-moderate- severe)
- **Asthma triggers**
- **Type of asthma before conrol**
- **Degree of asthma control**

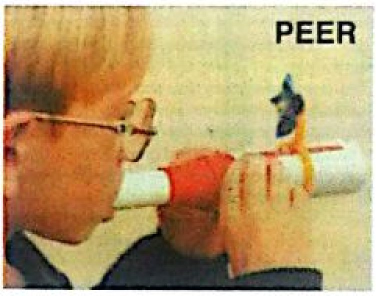
Clinical picture

History

1. Recurrent attacks of cough and or wheezes (mainly at night or early morning) that are relieved by bronchodilators
2. Cough , wheezes , chest tightness precipitated by triggers
3. Colds that go to chest and persists for 10ndays or longer
4. Other atopic manifestations e.g. eczema or atopic rhinitis
5. Family history of atopy.

Examination: the acute attach may be mild, moderate or severe

1. Inspection: manifestations of respiratory distress e.g. tachypnea and retractions.
2. Palpation: palpable rhonchi.
3. Percussion: hyperresonance.
4. Auscultation: harsh vesicular breathing with prolonged expiration and expiratory wheezes.



Investigations

Laboratory

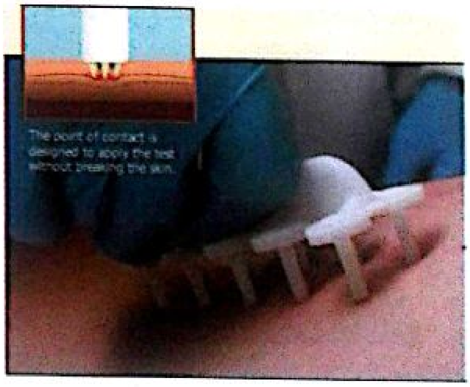
1. Blood gas and in acute severe asthma
2. Oxygen saturation by pulse oximetry in acute asthma
3. IgE: (total and specific to common antigens) and eosinophils: increased in atopic asthma.
4. Skin tests with common antigens to detect the cause.
5. Pulmonary function tests
   - Peak expiratory flow rate (PEFR) to assess the degree of airway obstruction.
   - Measurement of the degree of airway obstruction by spirometry e.g. FEV1: forced expiratory movement in the first second

Imaging: chest X ray

- It is indicated in suspected pneumothorax or pneumonia
  The lungs appear hyperinflated.

Differential diagnosis of asthma (causes of recurrent wheezes in infancy) P 116

Skin test with common allergens


The point of contact is designed to apply the test without breaking the skin.

1. Assessment of the child with acute asthma: clinical grading of acute asthma

Mild acute	Moderate acute	Severe acute
No respiratory distress	Evident respiratory distress: Tachypnea and some intercostal retraction.	Marked respiratory distress: .Tachypnea and marked retractions. .Too breathless to talk or feed . Tachycardia Cyanosis in life threatening attacks
Prolonged expiration and expiratory wheezes by Auscultation	Expiratory wheezes by auscultation that may be audible	. Expiratory wheezes by auscultation which is also audible. . Poor air entry or even silent chest in life threatening attacks
Home management	Emergency room	Hospital, better ICU

2. Determine the cause of the acute attack (triggering stimuli) by history and examination

Viral respiratory infection - Exposure to allergen - Severe exercise - Cold air.

3. Type of asthma

Asthma is a chronic disease. According to the frequency of symptoms (as night cough or wheezing), before starting treatment, asthmatic patients are classified into 3 types:

- **Intermittent asthma**: symptoms appear only during exacerbation.
- **Persistent asthma** symptoms are frequent in between attacks (it may be mild, moderate or severe according to the frequency of symptoms)
- **Seasonal asthma**: symptoms only appear in a certain season e.g. allergy to pollens in April and allergy to house dust mites in August and September.

- **Classification according to asthma severity before starting treatment (GINA)**

	1. Intermittent	2. Persistent		
		Mild	Moderate	Severe
Day symptoms	< once a week	> once a week	Daily	Daily
Night symptoms	≤ 2 per month	> 2 per month	> once a week	Frequent
Activity and sleep	Not affected	may be affected	Affected	Limited
Between attacks	Free	Symptomatic		
FEV1 or PEF (predicted value)	> 80%	>80%	60- 80%	< 60
FEV1 or PEF variability	< 20%	20 - 30%	> 30%	>30%

Spirometry

. FEV1 and PEF variability is the variation in the measurement over days or weeks. Increase variability →severe asthma and poor control

. Lung function is not reliable test for children 5 years and younger

Treatment

Treatment of acute attach
- **Mild**
- **Moderate**
- **Severe**

→ **Asthma reliever**

Preventive treatment
- **Asthma controlers**
- **Avpiding of triggering stimuli**
- **Patient and family education**

Treatment of acute mild to moderate attack

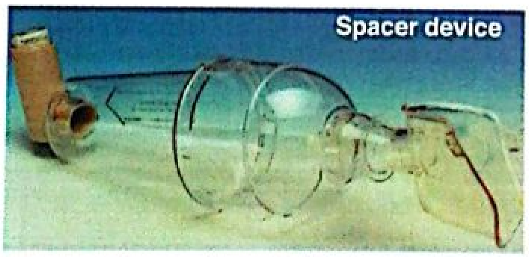
1. **Bronchodilators : relievers**
   Short acting B2 agonist
   - Preparation: Salbutamol – Terbutalin- Fenoterol
   - Route and dose :
     - Orally in mild attack. 0.2 – 0.3 mg/kg/day
     - Inhalation using spacer device for infants or inhalers for older children.

   Anticholinergic
   - Preparation: Ipratropium
   - Route and dose : inhalation : 250 microgram /dose (4 times /day)

   Theophylline (methylxanthine derivatives)
   - If B2 alone give little response.
   - Route and dose: orally or rectally 15-20 mg / kg /day.

2. **Corticosteroids**
   - In moderate cases, prednisone orally for few days.
   - Anti-inflammatory and interfere with synthesis of leukotriene and prostaglandins).

- **Mild cases**: one or 2 bronchodilators are given, inhaled bronchodilators are the best
- **Moderate cases**: inhaled bronchodilators and oral corticosteroids can be used.



Treatment of acute severe attack

1. Hospitalization: ICU in life threatening attack.
2. Humified O2 therapy to correct hypoxia.
3. IV fluids (maintenance therapy) to prevent dehydration.
4. Drugs
   - Nebulized salbutamol 0.25-0.5 ml added to 2-3 ml saline every 1-2 hours
   - IV (slowly) theophylline: 5 mg/ kg /6 hours.
   - IV hydrocortisone: 5-10 mg/kg/ 6 hours.
5. Assisted ventilation in cases with respiratory failure →
   - Pco2 above 55 mmHg.
   - Severe hypoxia
   - Severe acidosis or disturbed consciousness

Preventive treatment in between attacks

Drugs: Controllers

1. **Inhaled corticosteroids**
   - Decrease airway inflammation and bronchial hyperreactivity → decrease symptoms and asthma exacerbation.
   - No significant side effects when given in usual doses
   - Beclomethazone (4 doses/day) - Budesinide (2 doses) - Fluticasone (2doses).

2. **Inhaled long acting β2 agonist: Salmetrol:** usually with inhale corticosteroids.
3. **Leukotriene receptors antagonist** e.g. Montelukast 5-10 mg orally once daily
4. **Mast cell stabilizers e.g. Na cromoglycate (not commonly used nowadays)**
5. **Oral corticosteroids** e.g. Prednisone 2mg/kg/day (don't exceed 60 mg/day) usually given on alternate days to minimize side effects. In severe persistent asthma when other treatment has failed.

- **Avoidance of triggering stimuli e.g. common allergens, cold air.**
- **Immunotherapy is indicated in certain highly atopic patients**
- **Patient and family education about**

1. The nature of illness and the prognosis.
2. How to avoid triggering factors and how to use inhalers. The common trend of avoiding certain food (as eggs, chocolates) in all asthmatics is wrong
3. What to do in acute attack

Stepwise approach for managing chronic asthma: GINA

Step 1 Intermittent	Step 2 Mild persistent	Step 3 Moderate persistent	Step 4 Severe persistent
No daily medication needed only relievers when needed	**Preferred** Low dose ICS (Inhaled CorticoSteroids) with nebulizer or metered dose inhalation with a chamber	Low dose ICS + long acting β2 agonist **Or** Medium dose ICS	High dose ICS + long acting β2 agonist
	Alternative LRA(Leukotriene Receptor Antagonist)	Low dose ICS + LRA or Low dose ICS + sustained release theophylline	If needed add to the above: . LRA . Sustained release theophylline . Oral steroids

- Review every 1- 6 month and step up or down

Classification according to the degree of asthma control after starting controller medications (GINA) Global Initiative of Asthma Guidelines

Characteristic	Controlled All of the following	Partly controlled Any Feature in any week	Uncontrolled
Daytime symptoms	Non(≤ twice/week)	> twice/week	Three or more features of partly controlled asthma present in any week
Need for reliever	Non(≤ twice/week)	> twice/week	
Nocturnal symptoms	Non	Any	
Limitation of activity	Non	Any	
Lung function PEF or FEV1	Normal	< 80% predicted or personal best	
Exacerbations	Non	One or more/ year	One in any week

Prognosis

- Mild asthma: remission rate is 50%.
- Severe asthmatic patients who are steroid dependent: 95% become asthmatic adults.

Differential diagnosis of wheezing: differential diagnosis of asthma

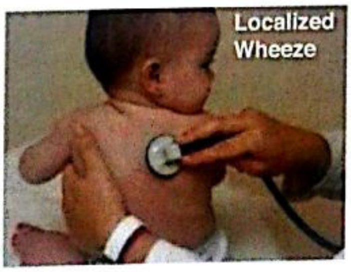
Definition

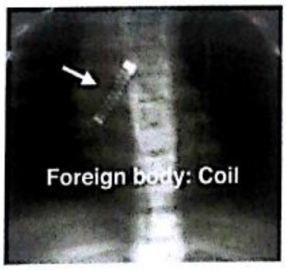
Expiratory wheezing is a continuous expiratory sound produced by partial obstruction (localized or generalized) at the level of the smaller bronchi and bronchioles.

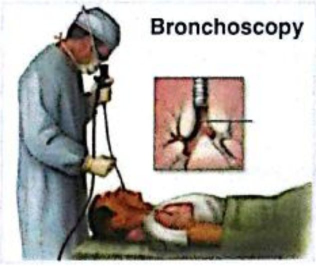
Etiology

Acute non recurrent wheeze: wheezing for the first time

1. **Acute bronchiolitis: the commonest cause of in infancy** : discuss
2. **Foreign body inhalation**
   - Symptoms: sudden onset of cough and choking.
   - Signs: unilateral or localized wheezing.
   - Investigations: X ray chest: may reveal collapse or emphysema.
   - Treatment: poor response to bronchodilators, bronchoscope will prove the presence of foreign body and it will help in its removal.



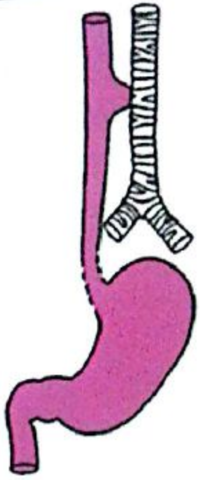




3. **Severe bronchopneumonia in infancy**
   - Fever, lethargy, poor feeding.
   - Respiratory distress (Tachypnea and chest retraction.)
   - Fine consonating crepitations over the affected area
4. **Organophosphorus poisoning:** excess chest secretions, pinpoint pupils, may be coma

Recurrent or persistent wheeze: ARF CCC

1. **The most common cause is bronchial asthma: discuss clinical picture**
   Recurrent aspiration ➔recurrent cough and wheezes since birth.
   - Gastroesophageal reflux
   - Tracheoesophageal fistula (H type)
3. Recurrent respiratory infections e.g.
   - Immunodeficiency
   - Cystic fibrosis
   - Bronchopulmonary dysplasia
4. Foreign body inhalation (not removed)
5. Pulmonary TB : **C**ompression of bronchi by lymph nodes
6. **C**ow milk allergy
7. **C**ongenital abnormality of lung, airway or heart.



Tracheoesophageal fistula (H type)

Differential diagnosis of cough: common causes of cough in infancy and childhood

Acute cough: duration less than 2 weeks

1. Without respiratory distress:-
   - Acute **bronchites**.
   - Acute laryngites
   - Acute sinusites
2. With respiratory distress:-
   - Acute **bronchiolitis**
   - Acute **asthma**
   - **Pneumonia**

Prolonged cough: duration is 2 weeks to 2 months

1. Complicated bronchitis (bacterial bronchitis, partial collapse, pneumonia)
2. Sinusitis
3. **Pertussis** and pertussis like illnesses

Recurrent or persistent cough (more than 2 months)

1. Asthma: the commonest cause of recurrent cough
2. Recurrent aspiration
3. Recurrent respiratory infections
4. Inhaled foreign body
5. Pulmonary TB: should always be excluded

} Discuss from wheezing

6. Allergic rhinitis: persistent nasal discharge →nocturnal cough
7. Cigarette smoking (active or passive).

Pediatric Allergic Disorders

Classification

. Asthma	. Allergic rhinitis	. Allergic conjunctivitis	. Food allergy
. Eczema	. Urticaria	. Insect bite allergy	. Drug allergy

Incidence

- Common: 40% of children develop allergic rhinitis, eczema and asthma
- Eczema and food allergy occurs in infancy
- Asthma and allergic rhinitis occurs in toddlers and childhood
- Allergic children may develop several allergic disorders at different ages "atopic march" theory

Prevention of allergic disorders (not effective)

1. Environmental manipulation (avoidance of allergens in pregnancy, during lactation or in infancy)
2. Probiotics (orally administered microorganisms which alter intestinal microflora),
3. Prebiotics (immunologically active oligosaccharides) and nutritional supplements (e.g. antioxidants, fish oils, trace elements).
4. Nutritional supplements e.g. antioxidants, fish oils, trace elements

Food Allergy and Food Hypersensitivity

Incidence

8 % of children.

Pathogenesis

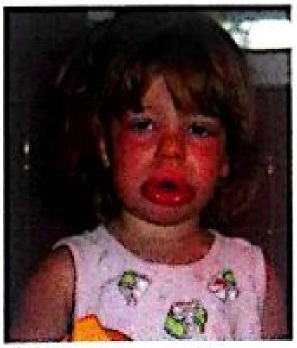
- It may be IgE mediated Or non-IgE mediated (non-allergic food hypersensitivity).
- Food intolerance is a less serious condition that does not involve the immune system.

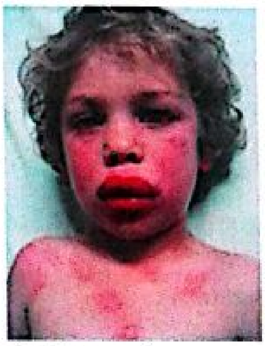
Etiology

- In infants the most common causes are milk, egg and peanut.
- In older children: peanut, tree nut and fish.
- Fruit allergy, although common, is usually mild, causing an itchy mouth but no systemic symptoms (oral allergy syndrome). Kiwi fruit, however, can cause anaphylaxis.

Clinical picture

Symptoms develop a few minutes to two hours after eating the offending food.
Food allergies can occur even the first time you eat a food even with small amount of food.





1. Skin : Hives, itching or eczema- Tingling or itching in the mouth

2. Subcutaneous : swelling of the lips, face, tongue and throat, or other parts of the body
3. Respiratory : wheezing, nasal congestion or trouble breathing
4. Abdominal: pain, diarrhea, nausea or vomiting
5. CVS : dizziness, lightheadedness or fainting

Food allergy can trigger a severe allergic reaction: anaphylaxis.

1. Constriction and tightening of airways → difficult to breath
2. Dizziness, lightheadedness or loss of consciousness
3. Shock, with a severe drop in blood pressure and rapid pulse
4. Untreated, anaphylaxis can cause a coma or death.

Food-associated exercise-induced anaphylaxis

A disorder in which exercise is tolerated and a food or foods are tolerated, but when exercise follows ingestion of a specific food or foods, anaphylaxis results

Investigations

1. Skin prick tests
2. Measurement of specific IgE antibodies in blood.
3. In cases of doubt, the gold standard investigation is the double-blind placebo-controlled food challenge. The child being given increasing amounts of the food or placebo

Skin prick test

Management

1. Avoidance of the triggering food. For milk and nuts, this is very difficult as they may be present in small quantities in many foods
2. Drug management
   - Mild reactions (no cardiorespiratory symptoms): antihistamines.
   - Severe reaction or has asthma, treatment is with epinephrine (adrenaline) IM or by auto-injector (e.g. Epipen)), which the child or parent should carry with them at all

Urticaria

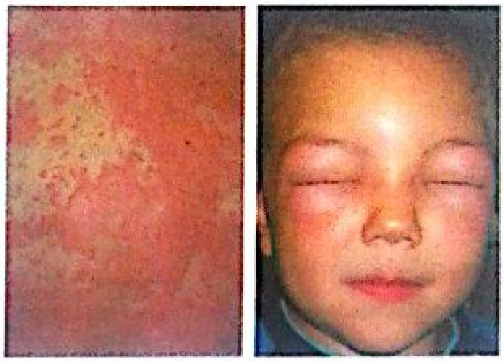
Types

- **Acute urticaria :exposure to an allergen or viral infection**
- **Chronic urticaria** (persisting >6 weeks)
  - It is usually non-allergic in origin (due to local increase in the permeability of capillaries and venules)
  - Most cases are idiopathic (cow's milk allergy may be the cause in some cases)

Etiology

1. Idiopathic (common)
2. Infection
3. IgE-mediated : foods e.g. cow's milk, peanuts , blood products or drugs e.g. penicillins

4. Pharmacological
   - Foods containing histamine-releasing substances, e.g. strawberries, egg white.
   - Aspirin and other non-steroidal anti-inflammatory agents
5. Physical agents :heat, cold, pressure



Clinical picture

1. Skin rash (wheals) and itching
2. Swelling of the deeper tissue
   → Edema of the lips and eye lids (angioedema)
3. It may progress to anaphylaxis

Atopic Eczema: Atopic dermatitis

Incidence

It affects around 10% of all infants and children.

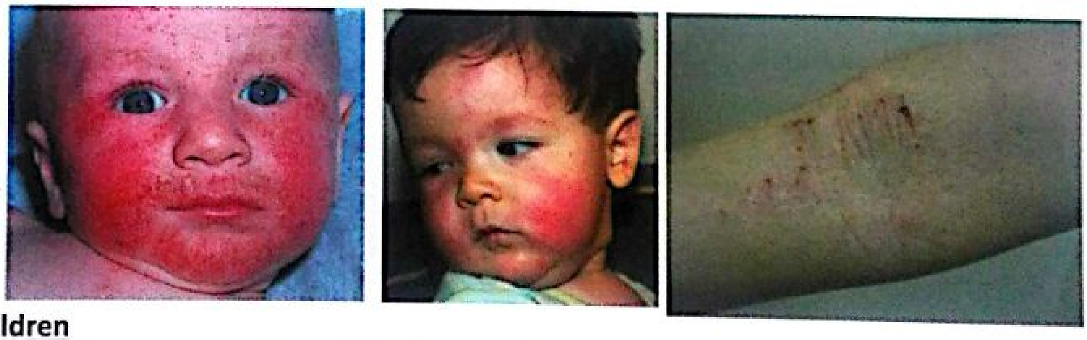
Etiology

1. Unknown, but it results from a combination of family heredity and a variety of conditions in everyday life that triggers the red, itchy rash .
2. Family history of allergy is usually positive
3. Up to 50% develop other allergic diseases. Some Infants have food allergy e.g. cow's milk allergy

Clinical picture

Infants

1. It begins early between 2 and 6 months.
2. It is termed: the itch that rash (itching usually occurs first)
3. It forms on the scalp and face, especially on the cheeks (can appear on other areas of the body).
4. The skin is dry, scaly, and itchy.
5. It can bubble up, then ooze and weep fluid.
6. Symptoms worsen and improve over time, with flare-ups occurring periodically



Children

1. A rash usually begins in the creases of the elbows or knees. Other common places are the neck, wrists and ankles.
2. Itchy, dray scaly patches.

Treatment

Life style changes

1. Avoid giving the child frequent hot baths, which tend to dry the skin.
2. Use warm water with mild soaps or no soap cleansers. Avoid using perfumed soaps.
3. Avoid excessive rubbing and toweling after bathing.
4. Avoid dressing the child in harsh or irritating clothing, Use soft cotton clothes.
5. Keep the child's fingernails short to minimize any skin damage caused by scratching
6. Avoid becoming overheated, which can lead to flare-ups.
7. Eliminate any known allergens such as certain foods, dust, or pet dander from house.
8. Have the child drink plenty of water, which adds moisture to the skin.

Medical treatment

1. Apply moisturizing ointments (such as petroleum jelly), lotions, or creams to the child's within a few minutes of bathing, two to three times a day.
2. Avoid alcohol-containing lotions and moisturizers, which can make skin drier.
3. Apply cool compresses (such as a wet, cool washcloth) on the irritated areas of skin.
4. Corticosteroid creams for short period to decrease the inflammatory reaction in the skin.
5. Oral antihistamines, if itching is severe.
6. Short course oral steroids is sometime given to control an acute eczema (not preferred)

Allergic Rhinitis: Hay Fever

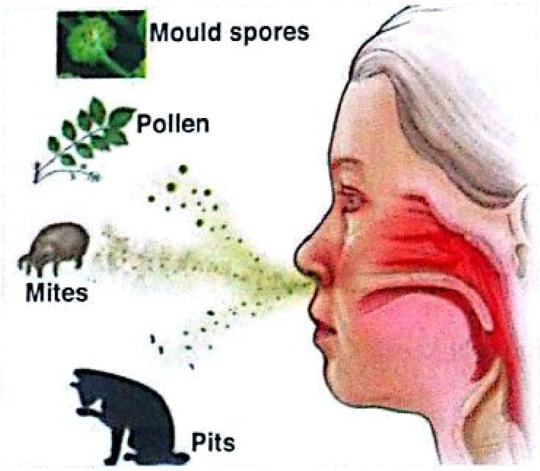
Incidence

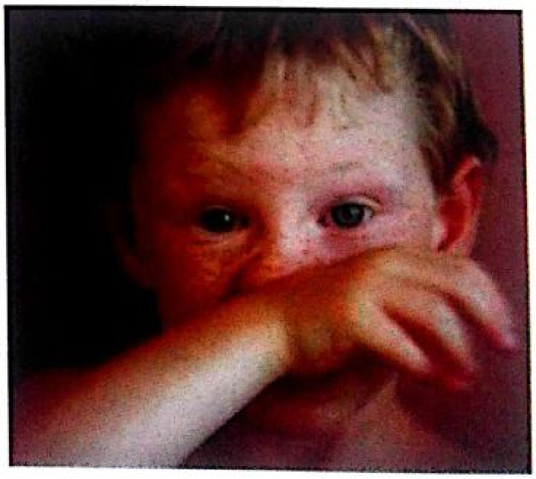
Very common: up to 20% of children

Etiology

1. Seasonal allergic rhinitis due to exposure to airborne pollens and spores (tree pollens in the spring, grass pollens in the summer, and mould spores in the autumn)
2. Perennial allergic rhinitis due to exposure to house dust mite or pet dander

1. Rhinorrhea, nasal congestion, postnasal discharge →cough variant rhinitis
2. Repetitive sneezing
3. Itching of the palate, nose, ears, or eyes
4. It is associated with eczema, asthma, sinusitis and adenoidal hypertrophy.





Treatment

1. Antihistaminics (singly or in combination)
2. Steroid nasal sprays
3. Cromoglycate eye drops
4. Leukotriene inhibitors
5. Oral steroids
6. Specific immunotherapy

Treatment of allergic rhinitis has been shown to improve coexistent asthma

Insect Bite or sting Hypersensitivity

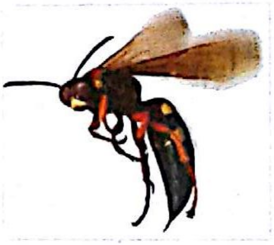
Etiology

The commonest causes are: bee sting, wasp sting

Clinical picture

1. Mild: local swelling
2. Moderate: generalized urticaria
3. Severe: systemic symptoms with wheeze or shock
   Children with a previous mild or moderate reaction are unlikely to develop severe reaction in the future (reassure the family)

Bee sting



Wasp

Treatment

1. Children who had a severe reaction should carry an epinephrine (adrenaline) auto-injector and be desensitized using specific immunotherapy.

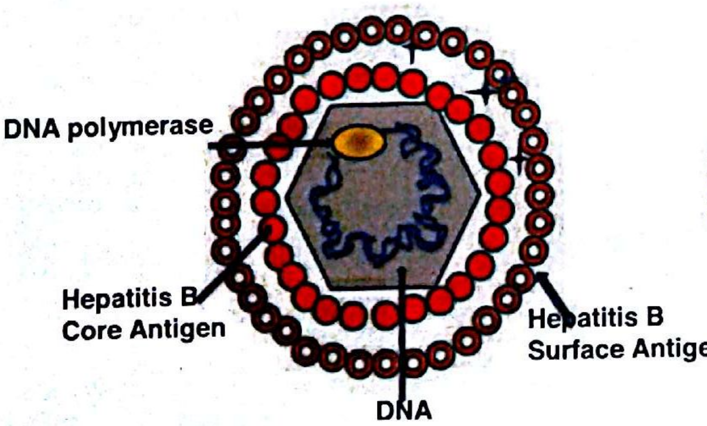
Drug Allergy

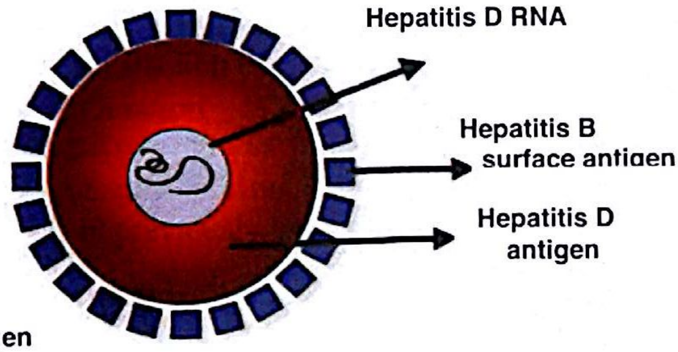
- Drug allergy e.g. allergy to antibiotics are uncommon in children.
- Viral infections for which children are usually given antibiotics, present with skin rashes that commonly misdiagnosed as drug allergy.
- Allergy skin tests and blood tests are unreliable in diagnosing drug rash.
- Drug challenge is the only way to confirm the diagnosis.

Viral Hepatitis

Hepatotropoic viruses: A, B, C, D, and E

Hepatitis A **The commonest**	**Hepatitis B**	**Hepatitis C**	**Hepatitis D**	**Hepatitis E**
Type of virus RNA Enterovius	DNA Hepadnavius	RNA Flavvirus	RNA Incomplete virus	RNA Calcivirus
Transmission . Feco-oral	. Parenteral . Vertical . Sexual	. Parenteral . Vertical . Sexual??	. Parenteral . Vertical . Sexual	. Feco-oral
Incubation P 2-6 weeks	2-6 months	1-5 months	3-6 weeks	2-9 weeks
Diagnostic test Anti-HAV IgM	HBsAg Anti HBc IgM	Anti-HCV HCV-RNA	Anti-HDV	Anti-HEV
Fulminant form Rare	Yes	Rare	Yes Cannot produce infection without virus B infection because it has no surface coat	Yes
Chronicity No	Yes	Yes(common)	Yes	No
Vaccine Yes	Yes	No	Yes (HBV)	No





Other viruses: cause systemic manifestations that sometimes affect the liver

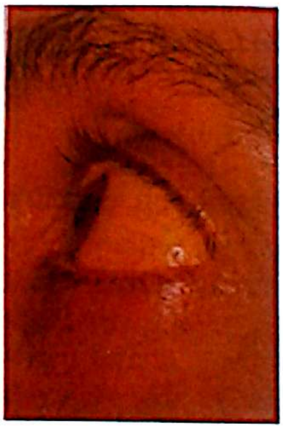
- Epstein-Barr virus: in 40 % of cases, less than 5% become jaundiced
- Cytomegalovirus
- Herpes simplex virus.
- Others

Clinical types of acute hepatitis: Acute hepatitis can present with one of 4 clinical types.

1. **Icteric hepatitis: it is the commonest form(3 stages)**
   - **Pre-icteric stage: 4-6 days**
     - Fever, anorexia, headache and malaise.
     - Abdominal pain and vomiting.
     - Urine usually becomes dark(bilirubinemia) during the last 1-3 days
   - **Icteric stage: 2-4 weeks**
     - Jaundice, dark urine and clay colored stool.
     - Liver is enlarged and tender.
     - The early manifestations as fever, vomiting disappear but anorexia may continue
   - **Convalescence stage** :gradual decline of jaundice and decrease in liver size

2. **Cholestatic hepatitis**
   - Marked obstruction of biliary flow →
   - Pruritus (bile acids) and marked clay colored stool.
3. **Anicteric hepatitis**
   - Commoner in infancy.
   - Jaundice is absent, presentations include: anorexia, vomiting, diarrhea and colic
4. **Fulminant hepatitis:** acute liver failure (the least common but the most serious:70% mortality)
   - Progressive jaundice, bleeding, and encephalopathy
   - Later on, Cerebral edema, hemorrhage from coagulopathy and sepsis

Dark urine



Jaundice

Enlarged tender liver

Diagnostic investigations of acute hepatitis (acute liver injury)

1. **To prove acute hepatitis**
2. **To exclude acute liver cell failure**
3. **To diagnose the cousative virus**

To prove acute hepatitis

1. Bilirubin: direct or mixed hyperbilirubinemia.
2. AST (aspartate aminotransferase) and ALT (alanine aminotransferase) are elevated (10 folds).
3. Urine analysis: bilirubin is present.

To exclude acute hepatic failure AAAAA BP H

1. Raising Bilirubin level (above 10 mg/dl, level above 20 mg/dl may also occur).
   Reye syndrome bilirubin level is normal
2. Liver transaminases (ALT, AST) are increased (10 -100 times normal).
3. Increased **A**lkaline phosphatase.
4. Low serum **A**lbumin (below 3 gm/dl). and prothrombin concentration
5. Prolonged **P**rothrombin time (more than 20 seconds).
   INR (international normalized ratio) ≥2, uncorrectable with vitamin K or INR between 1.5 and 1.9 uncorrectable with vitamin K plus encephalopathy.
6. High **A**mmonia level (above 150 mcg/dl).
7. Metabolic **A**cidosis.
8. Hypoglycemia, Hypokalemia and Hyponatremia.

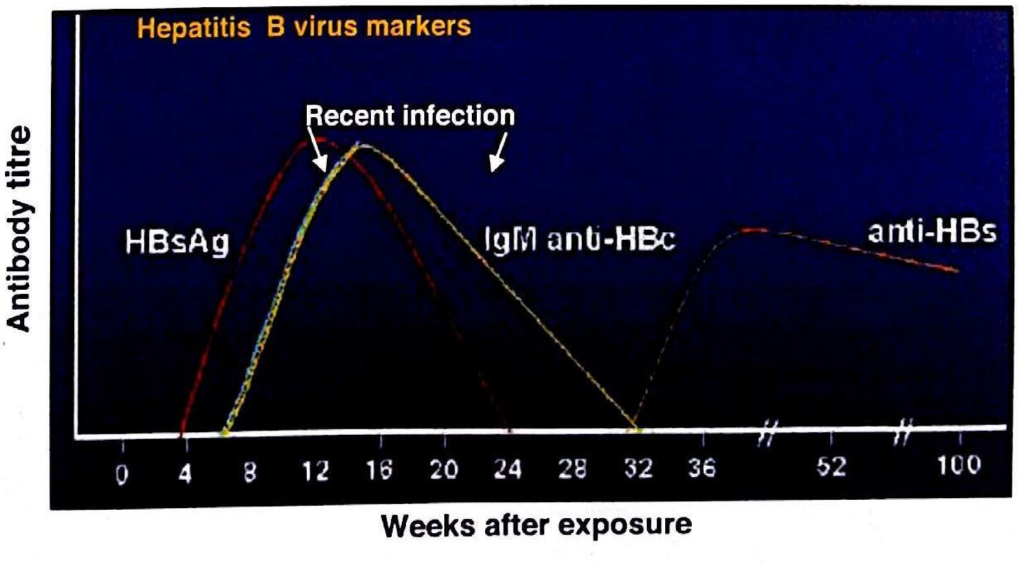
To diagnose the causative virus

1. **Hepatitis A**
   - IgM antibodies to hepatitis A (anti HAV IgM): recent infection(acute disease).
   - IgG anti HAV antibodies persist after recovery (immunity).

2. **Hepatitis B**
   - HBsAg (surface antigen) followed by anti HBc (core antibodies) IgM: indicate recent infection.
   - Anti-HBs (surface antibodies) appear after recovery and indicate immunity.
   - Persistence of HBsAg (surface antigen) and anti HBc IgG indicate chronicity.

3. **Hepatitis C**
   - Anti-HCV antibodies: these antibodies denote exposure to infection but do not mean recovery or development of immunity.
   - HCV- RNA antigen detected by PCR (polymerase chain reaction) denotes viremia
   - Viral load can be assessed by quantitative PCR for treatment purposes

4. **Hepatitis D, and E**
   - Anti – HDV and anti HEV antibodies (IgM).
   - Hepatitis D virus antigen



Prevention

General measures

1. **HAV**
   - Isolation of acute cases for 7 days after onset of jaundice (infectivity period).
   - Strict hand washing, especially after changing diapers and before preparation or serving food.
2. **HBV , HCV, and HDV**
   - Strict screening of blood and blood products.
   - Strict sterilization for all procedures in which there is contact with blood
   - Prevention of perinatal transmission during delivery of infected mothers

Vaccination

1. **HAV** : discuss from noncompulsory vaccination P 280
2. **HBV**
   - Vaccination discus from compulsory vaccines P 279
   - Perinatal transmission from carrier mothers should be prevented by maternal screening and giving the infant hepatitis B vaccine with hepatitis B immunoglobulin.
3. **HCV**: No available vaccine.

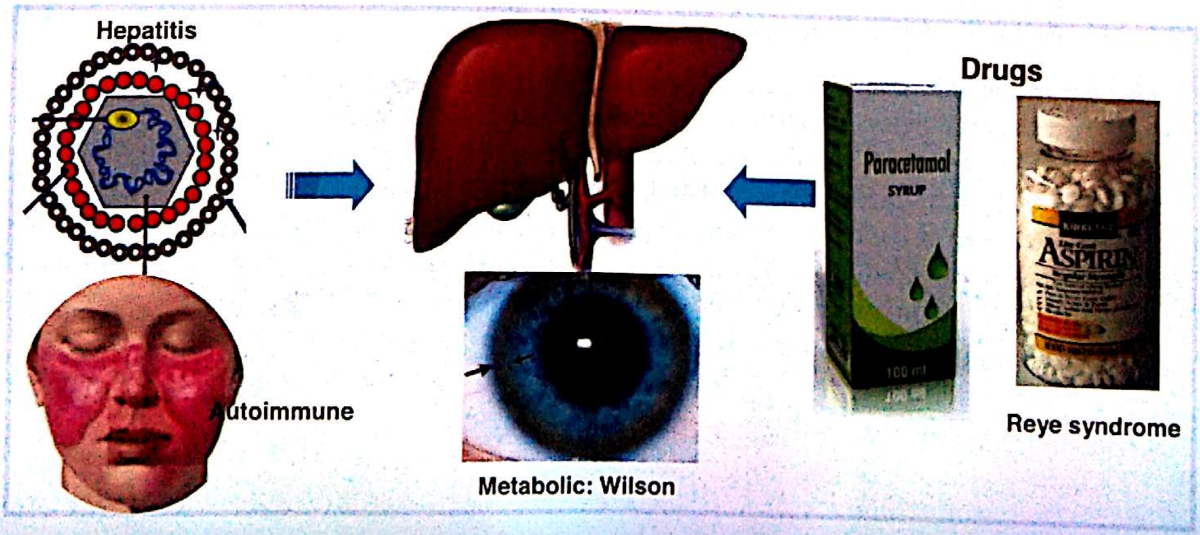
Acute liver cell failure: acute fulminant hepatitis

Definition

Sudden loss of liver functions (metabolic, excretory, detoxifying) caused by rapid death or injury to a large proportion of hepatocytes with or without hepatic encephalopathy. It is a very serious condition with bad prognosis and high mortality.

Etiology **MRD: AH**

1. Infections: **H**epatitis B (the commonest cause) or less commonly A, D, cytomegalovirus and Epstein Barr virus.
2. **A**utoimmune disorders.
3. **D**rugs: paracetamol, isoniazid, halothane, non-steroidal anti-inflammatory drugs and erythromycin
4. **R**eye syndrome: acute non inflammatory encephalopathy with fatty infiltration, close association with aspirin therapy in varicella or influenza.
5. **M**etabolic: Tyrosinemia and galactosemia and Wilson disease.



Pathophysiology and clinical picture

Pathophysiology	Clinical picture
Disturbed hepatic metabolic functions	
1. Coagulopathy (decreased synthesis of coagulation factors)	Bleeding tendency mainly GIT(stress ulcers) and easy bruising
2. Retention of some amino acids (methionine and glutamine) and same short chain fatty acids	Hepatic encephalopathy
3. Neutophilic dysfunction	Secondary bacterial infection(sepsis) ➔systems failure➔ respiratory failure
4. Hypoalbuminemia	Fluid retention and ascites
5. Electrolyte disturbances : hyponatremia, hypokalemia and hypoglycemia	
Disturbance of hepatic excretory functions	
1. Elevated serum bilirubin except in Reye $	Progressive jaundice except in Reye$
2. Elevated serum bile salts	Renal failure (hepatorenal syndrome)
Disturbed hepatic detoxifying functions	
1. Elevated ammonia level (it is the main mechanism of brain edema and encephalopathy	Persistent vomiting Brain edema➔Hepatic encephalopathy Brain edema may be also due to cerebral vasodilatation, hyponatremia and hypoalbuminemia

Investigations: P 124

Management

Close monitoring

1. Clinical monitoring
   - Vital signs
   - Level of consciousness
   - Urine output, edema and ascites
   - Signs of brain edema, bleeding and evidence of infections
2. Laboratory monitoring
   - Liver functions, prothrombin time kidney functions
   - Blood ammonia, blood sugar, serum electrolytes

Conservative measures

1. Correction of water , electrolytes imbalance and feeding
   - IV fluids and IV salt free albumin
   - Feeding oral / nasogastric or Total parenteral nutrition
2. Reduction of ammonia level :reduce protein intake, Neomycin and Lactulose (oral or enema)
3. Control of bleeding: fresh frozen plasma or fresh whole blood, IV vitamin K and antacids
4. Control of infections : antibiotics guided by cultures
5. Control of fluid retention and ascites: fluid restriction ± diuretics
6. Brain edema: head elevation, IV drip Mannitol and therapeutic hyperventilation

Drastic measures

1. Charcoal hemoperfusion
2. Liver transplantation

Chronic hepatitis

Definition

Continuing inflammatory disease of the liver for *more than 6 months* with the potential to either:-

1. Progress to more severe disease including cirrhosis
2. Continue unchanged
3. Subside with or without treatment

Etiology = causes of liver cirrhosis

1. Chronic viral hepatitis(B, C,D) : (A and E do not cause chronic liver disease)
2. Autoimmune chronic hepatitis.
3. Drug induced (INH, Rifampicin).
4. Metabolic disease: Wilson disease (- alpha 1 antitrypsin
5. Chronic inflammatory bowel disease e.g. ulcerative colitis.
6. Primary sclerosing cholangitis ± ulcerative colitis.

The commonest causes are post viral hepatitis (B, C, D) followed by autoimmune hepatitis

Clinical picture

1. Chronic post viral hepatitis

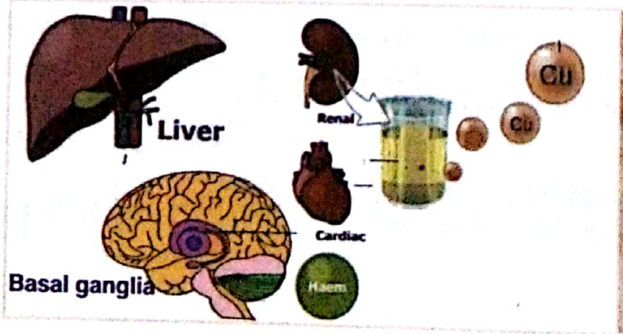
- May start as acute hepatitis which fails to resolve within 6 month or as insidiously progressing liver disease or may be accidentally diagnosed in an asymptomatic child.
- The following manifestations may be present: Jaundice, Hepatosplenomegaly and Manifestations of liver cell failure (bleeding tendency, palmer erythema, spider nevi etc.)

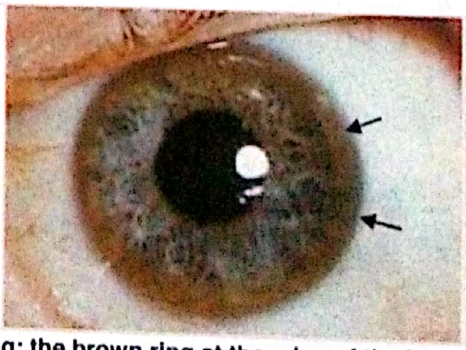
2. In autoimmune hepatitis

- The mean age of presentation is 7-10 years and it is more common in girls.
- It may present as an acute hepatitis, as fulminant hepatic failure or chronic liver disease
- Autoimmune features such as skin rash, lupus erythematosus, arthritis or nephritis.

3. Wilson

- Autosomal recessive disorder
- There is reduced synthesis of ceruloplasmin (the copper binding protein) → accumulation of copper in the liver, brain, kidney and cornea (kayser-Fleischer ring).
- **Hepatic manifestations**
  - Rarely presents in children under the age of 3 years.(usually in children less than12 years)
  - It may present with any form of liver disease including acute hepatitis, fulminant hepatitis, cirrhosis and portal hypertension.
- **Extra hepatic manifestations are common**
  - Neurological features are in the second decade e.g. extrapyramidal signs.
  - Hemolytic anemia.

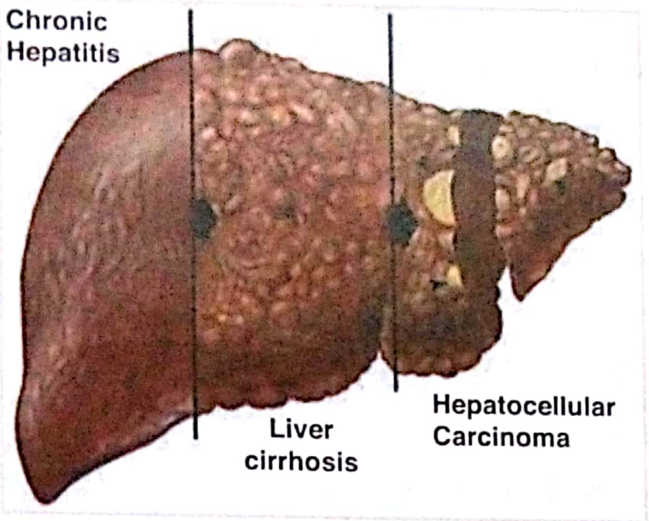


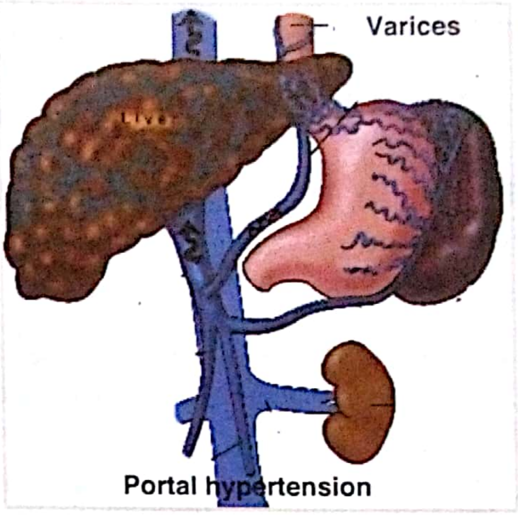


Kayser- Fleischer ring: the brown ring at the edge of the iris

Complications

1. Cirrhosis and hepatocellular carcinoma especially with chronic HBV and HCV infection.
2. Portal hypertension (Varices, ascites).
3. Liver cell failure.





Investigations (of chronic hepatitis or hepatosplenomegaly or liver cirrhosis)

Investigations to assess liver functions: liver function tests are usually abnormal

1. Bilirubin level, total and direct.
2. Enzymes: ALT, AST and alkaline phosphatase.
3. Alkaline phosphatase and gamma glutamyl transpeptidase.
4. Plasma proteins.
   Prothrombin time, prothrombin concentration and INR

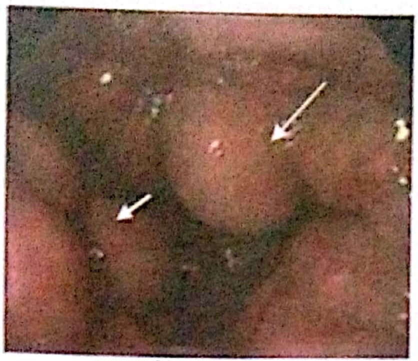
Investigations to search for the etiology

1. **Laboratory**
   - **In post viral chronic hepatitis:** Hepatitis markers e.g. persistence of HBsAg.
   - **In autoimmune hepatitis**
     - Hypergammaglobulinaemia.
     - Positive autoantibodies, e.g. anti-smooth muscle antibodies, antinuclear antibodies or liver/kidney antibodies.

   In Metabolic disorders
   - Wilson disease
     - Low serum ceruloplasmin, low serum copper.
     - Excess urine copper and increased hepatic copper.
     - Kayser-Fleischer rings by slit lamp examination. (copper accumulation in the cornea)
   - $\alpha_1$antitrypsin deficiency: α_1 antitrypsin assay.
2. **Imaging**:
   - Ultrasound: to assess liver texture, portal vain caliber and the presence of ascites
   - Doppler : to assess portal vein patency, direction of blood flow and the presence of porto systemic anastomosis

3. **Endoscopy:** upper GIT Endoscopy may show esophageal varices.
4. **Study of ascetic fluid tap**

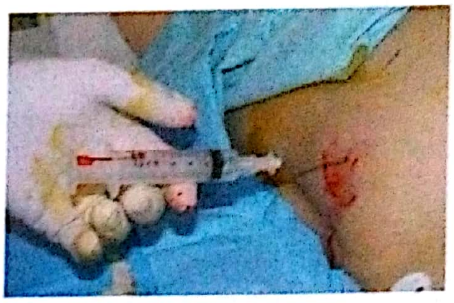
5. **Liver biopsy** :assesses the grade of inflammation and stage of fibrosis



Varices

Upper endoscopy

Ascetic tap



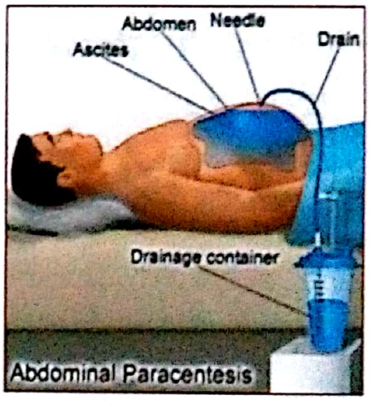
Liver biopsy

Treatment

Treatment of any correctable condition

1. Post viral: oral Antiviral drugs e.g. ribavirin and long acting interferon
2. Autoimmune hepatitis: Ninety per cent of children will respond to prednisolone and Azathioprine.
3. Wilson disease: Penicillamine is a copper chelating agent (promotes urinary copper excretion)

Liver supportive measures



1. **Nutritional support**
   - Vitamin, minerals and carbohydrate rich diet.
   - Fat in the form of medium chain triglycerides.
2. **Pruritis**
   - Phenobarbitone
   - Cholestyramine (bile acid binder)
3. **Ascites**
   - Sodium and fluid restriction and diuretics.
   - Albumin infusions or Paracentesis for refractory ascites
4. **Encephalopathy**
   - Treat precipitating factors e.g. GIT bleeding
   - Protein restriction
   - Oral lactulose to reduce ammonia reabsorption (it lower colonic pH and increase colonic transit)

Liver transplantation in end stage liver disease: survival rate 70-90%

Neonatal And Infantile Cholestasis

Definition

It is decrease in bile flow to the intestine due to impaired secretion by hepatocytes or to obstruction of bile flow through intra-or extra hepatic bile ducts.

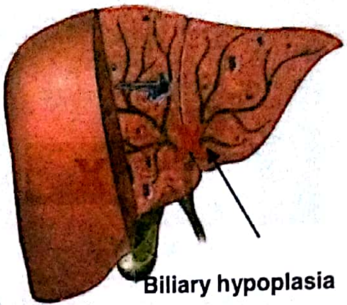
There is **prolonged** elevation of direct **(conjugated)** bilirubin more than 20 % of the total bilirubin, together with cholesterol and bile acids.

Etiology

Intrahepatic disease

- **Liver cell injury**

1. **Idiopathic or giant cell hepatitis** (no evident etiology): the commonest cause
2. **Infections**
   - TORCH infections (enumerate)
   - Sepsis



Biliary hypoplasia

- **Metabolic disorders**
  - Carbohydrate metabolism
  - Galactosemia
  - Protein metabolism: tyrosinemia
  - Lipid metabolism : Niemann –Pick disease
  - Others : α-1 antitrypsin deficiency, bile acid synthesis defects

- **Intrahepatic bile duct lesion: biliary hypoplasia**

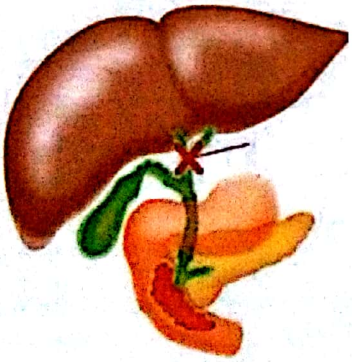
1. Progressive familial intrahepatic cholestasis
2. Benign recurrent intrahepatic cholestasis
3. Alagille syndrome (congenital heart disease, cholestasis and abnormal features).

Extrahepatic disease

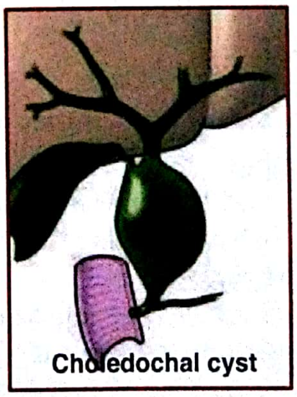
- **Extra-hepatic biliary atresia**

1. Obstruction at or above porta hepatis: 85% of cases
2. Distal atresia with patent extrahepatic duct up to porta hepatis (rare)

- **Choledochal cyst**: cystic dilatation of the extrahepatic biliary system



Extrahepatic biliary atresia



Choledochal cyst

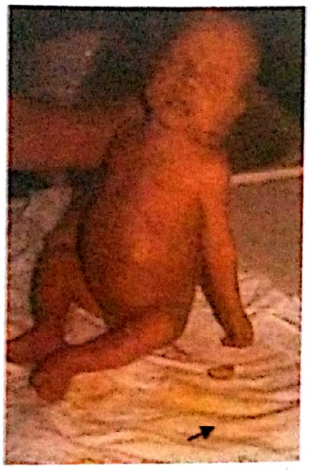
The commonest causes are idiopathic hepatitis and extrahepatic biliary atresia.

Early differentiation is important because in case of biliary atresia early surgical correction will prevent further hepatic damage.

Clinical manifestations and consequences of cholestasis

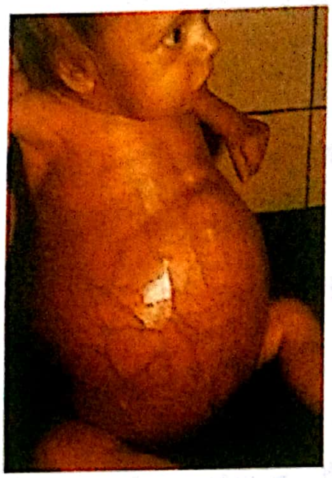
History

1. **Present History**
   - Onset of jaundice: cholestasis should be considered in every case with persistent jaundice for more than 2 weeks, with clay colored stool and dark urine.
   - In biliary atresia: jaundice is not evident immediately at birth, but develops in the first 1- 2 weeks of life. The stool is persistently pale or clay colored. Liver injury progress rapidly to cirrhosis and portal hypertension
   - In neonatal hepatitis: jaundice, enlarged liver and ill appearing infant are evident at birth.
2. **Prenatal history**: to exclude congenital infections.
3. **Family history of similar conditions and consanguinity in genetic causes.**



Clay colored stool

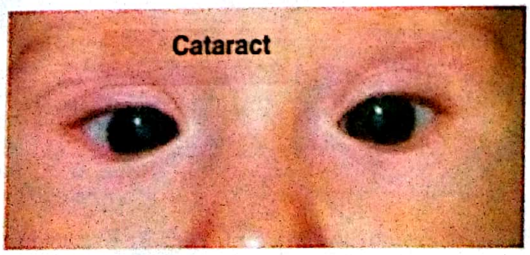
Dark urine



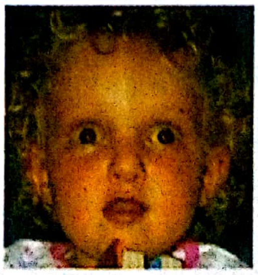
Examination

1. **Hepatomegaly** is usually present, huge liver suggest biliary atresia
2. **Manifestations due to retention and regurgitation of bile acids** :→ pruritus (itching marks)
3. **Manifestations due to decrease bile flow to the intestine:-**
   - Malabsorption of fat → malnutrition → steatorrhea (bulky offensive stool).
4. **Manifestations due to progressive liver cirrhosis in long standing cholestasis:-**
   - Portal hypertension (ascites, hematemesis).
   - Liver cell failure (bleeding tendency).
5. **Manifestations of specific cause** e.g.
   - Cataract suggests congenital rubella infection or galactosemia.
   - Low birth weight or microcephaly, rash may be present with congenital infections.
   - Allagille syndrome (abnormal facies, congenital heart, vertebral anomalies).

N.B: Fundus examination is a part of routine examination in cholestasis.



Cataract



Allagille syndrome

Investigations: laboratory approach for cholestasis

Investigations to diagnose cholestasis

1. Increased total and direct bilirubin (direct bilirubin ≥ 20% of total bilirubin)
2. Increased AST (aspartate transferase) and ALT (alanine transferase)
3. Increased alkaline phosphatase and **G**amma **G**lutamyl **T**ranspeptidase (GGT is normal in progressive familial intrahepatic cholestasis and bile acid synthesis defects)
4. Decreased total serum proteins.
5. Prolonged prothrombin time , decreased prothrombin concentration and increased INR

Investigations to determine the cause (5 steps):-

1. **Search for treatable cause**
   - Galactosemia: reducing substance in urine or Galactose 1phosphate in blood while the infant is receiving a lactose containing formula.
     Measuring the enzyme galactose-1-phosphate-uridyl transferase in red cells.
   - Septicemia and other bacterial infections: CBC, CRP, ESR, cultures.

2. **Search for TORCH infections**
   - Total IgM antibody: level above 18-20mg/dl is highly suggestive.
   - TORCH screening; specific antibodies of TORCH agents e.g. CMV

3. **Search for metabolic conditions**
   - α_1 antitrypsin assay ($\alpha_1$antitrypsin deficiency): normal serum level 150-250mg/dl
   - Tyrosinemia: → succinyl acetone in urine and aminogram.
   - Niemann-pick disease: bone marrow examination and specific enzyme assay

4. **Exclude for choledochal cyst**: By abdominal ultrasonography.
5. **Differentiation between neonatal hepatitis and extrahepatic biliary atresia**
   - Liver scan (HIDA)
     - In extra hepatic biliary atresia: no excretion of dye in the intestine.
     - In hepatitis excretion of dye in the intestine can occur.
   - Liver biopsy
     - In neonatal hepatitis: giant cell transformation and degeneration of hepatocyte.
     - In atresia: expansion of portal areas with fibrosis and bile duct proliferation.

Treatment

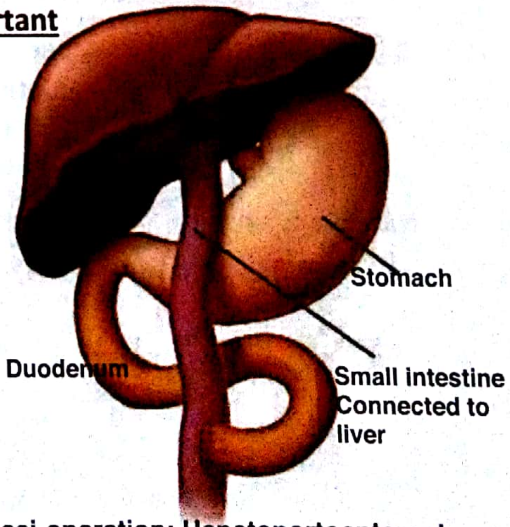
Extra hepatic biliary atresia: early diagnosis is very important

1. Correctable lesion (rare): direct drainage.
2. Non correctable lesion: Kasai operation, it must be done before 60 days to obtain best results.
3. Liver transplantation for end stage liver disease
   Biliary atresia is the commonest indication for liver transplantation in infancy.

Treatment of correctable conditions.

1. Antibiotics for septicemia or urinary tract infections
2. Elimination of lactose from diet in Galactosemia.
3. Surgical treatment of choledochal cyst

Liver supportive measures: discuss P 129

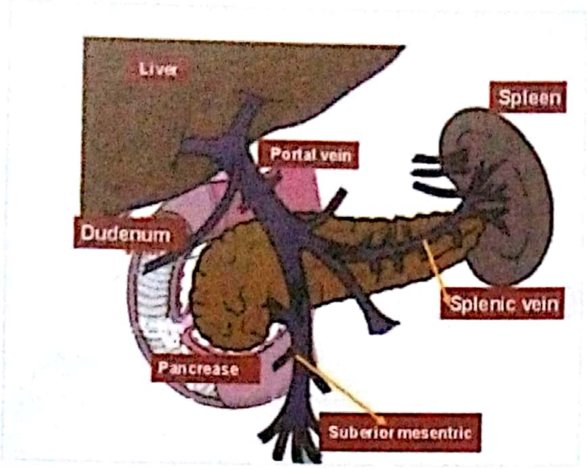


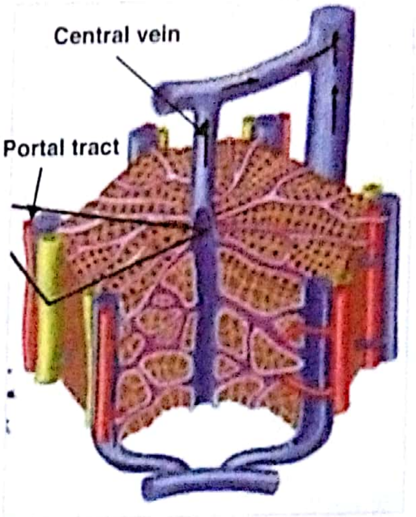
Kasai operation: Hepatoportoenterostomy

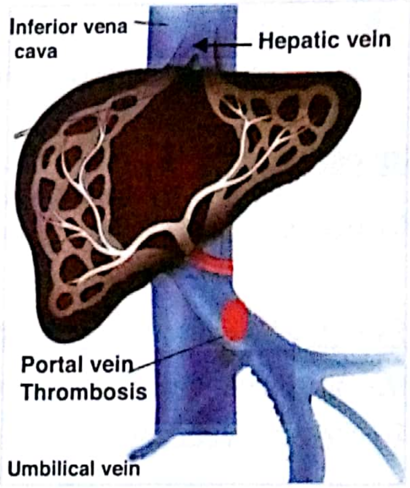
Portal Hypertension

Definition

Increased pressure in the portal circulation above 10-12 mmHg (N: 7-10 mmHg).

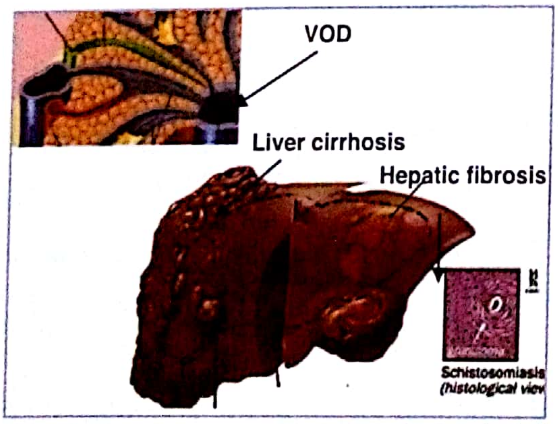


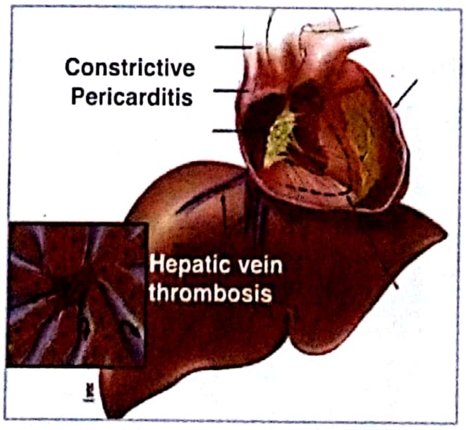




Etiology

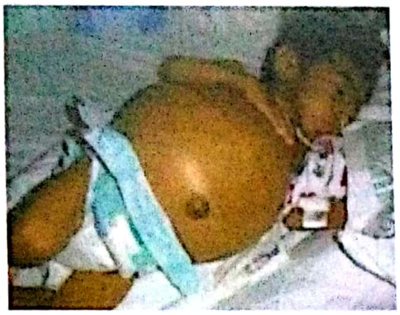
1. **Pre-hepatic** Causes in the portal or splenic vein
   Portal vein thrombosis or splenic vein thrombosis
   - Umbilical sepsis
     Omphalitis→ thrombophlebitis of the umbilical vein is the most common
   - Umbilical vein catheterization.
2. **Hepatic**
   - **Presinusoidal:** causes in the portal tracts
     - Congenital hepatic fibrosis
   - **Sinusoidal** : liver cirrhosis due to
     - Chronic hepatitis : enumerate causes
     - Cystic fibrosis
     - Biliary atresia
   - **Post sinusoidal** : central vein thrombosis
     - VOD (veno-occlusive disease) may be classified as post hepatic also
3. **Post hepatic**
   - Hepatic vein thrombosis(Budd-Chiari syndrome)
   - Constrictive pericarditis



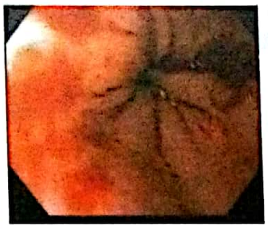


Clinical presentation of portal hypertension

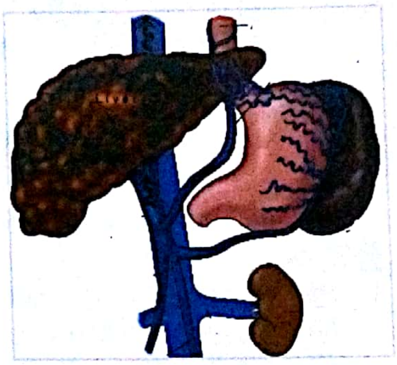
1. **Hematemesis** from esophageal Varices (may be the first presenting symptom)
2. **Abdominal examination**
   - Dilated abdominal wall veins (site of porto systemic anastomosis)
   - Ascites; become evident with advanced cases (due to hypoalbuminemia, sodium retention).It occurs early in post sinusoidal portal hypertension
3. **Organomegaly**
   - Pre hepatic: significant early splenomegaly with normal liver (hypersplenism may occur resulting in pancytopenia.
   - Hepatic: mild to moderate splenomegaly, enlarged or shrunken according to the disease
   - Post hepatic: liver: marked hepatomegaly, normal spleen



Ascites and Organomegaly



Bleeding oesophageal Varices



Investigations: investigations of chronic hepatitis **P**: 128

Don't forget upper endoscopy, ultrasound and Doppler

CT angiography and MRI venography are rarely needed to demonstrate vessels patency

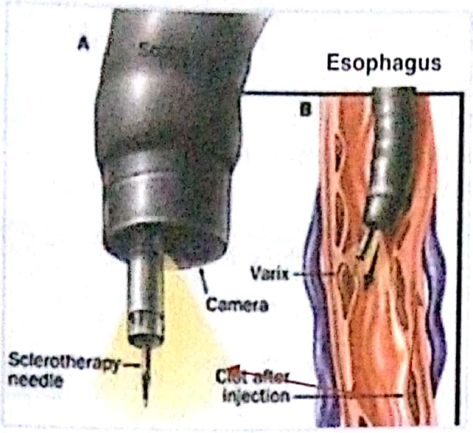
Prevention and management of variceal hemorrhage

Management of variceal hemorrhage

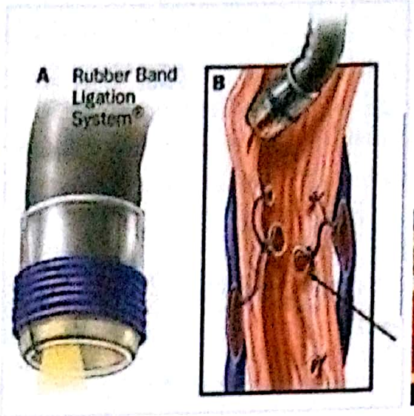
1. **Emergency therapy for bleeding varices**:-
   - Anti-shock measures: blood transfusion, intravenous fluids.
   - Correction of coagulopathy: vitamin k, fresh plasma, platelets transfusion.
   - Nasogastric tube placement.
   - H2 receptor blocker (ranitidine) IV to decrease risk of bleeding from gastric erosion
   - Vasopressin infusion if bleeding persists.
2. **Emergency endoscopy** and either injection sclerotherapy or band ligation.
3. **Emergency shunt**: Porto systemic shunt. Or stent placement

Prevention of bleeding from varices

1. **Prevention of the first attack of bleeding**
   - Avoid aspirin and non-steroidal anti-inflammatory drugs.
   - B adrenergic blockers (Propranolol) to lower the pressure in portal area.
   - Prophylactic sclerotherapy or band ligation.
2. **Prevention of re-bleeding; in addition to the above, the following may needed**:-
   - Surgical Porto systemic shunt
   - Liver supportive measures : P129
   - Liver transplantation



Injection sclerotherapy



Rubber band ligation system

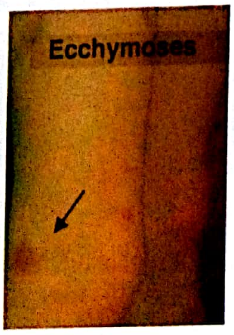
Banded varices

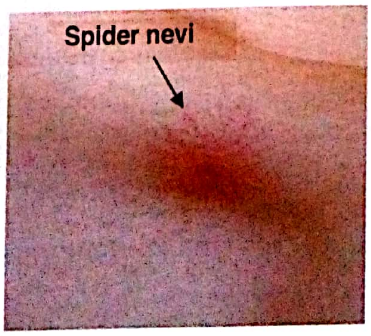
Clinical Presentations Of Liver Disease

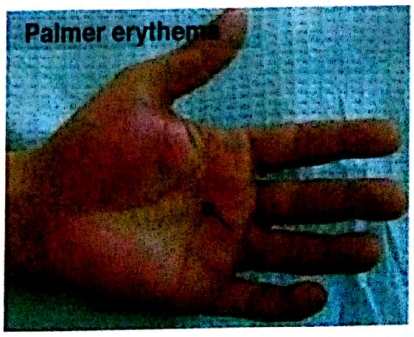
1. Jaundice: conjugated (cholestasis) and unconjugated : enumerate causes
2. Portal hypertension: manifestations : P 134
3. Organomegaly
4. Liver cell failure
5. Others :
    Hepatopulmonary syndrome
    Hepatorenal syndrome
    Bone disease: hepatic rickets

Manifestations of Chronic liver cell failure

1. General: anorexia, weight loss (malnutrition) and easy fatigue.
2. Jaundice: conjugated hyperbilirubinemia and pruritus.
3. Ascites (hypoproteinemia and portal hypertension) and lower limbs edema.
4. Bleeding due to hypoprothrombinemia and esophageal varices.
5. Cutaneous manifestations: palmar erythema, spider nevi, bruising and petechiae.
6. Hepatic encephalopathy: precipitated by infections or bleeding.







Causes of hepatomegaly

1. **Storage**
   - Fat: malnutrition, obesity, cystic fibrosis, metabolic liver disease
   - Lipid storage diseases: Niemann-Pick disease, Gaucher disease
   - Glycogen: glycogen storage diseases, infant of diabetic mother
   - Miscellaneous: alpha-1-antitrypsin deficiency, Wilson disease, Schistosomiasis (rare now)
2. **Inflammation**
   - Acute and chronic viral hepatitis
   - Liver abscess
   - Autoimmune hepatitis

3. **Infiltration**
   - Primary liver tumors
     Benign: infantile hemangiendothelioma
     Cystic: choledochal cyst
     Malignant: hepatoblastoma, hepatocellular carcinoma
   - Secondary or metastases: neuroblastoma, histiocytosis, leukemia, lymphoma

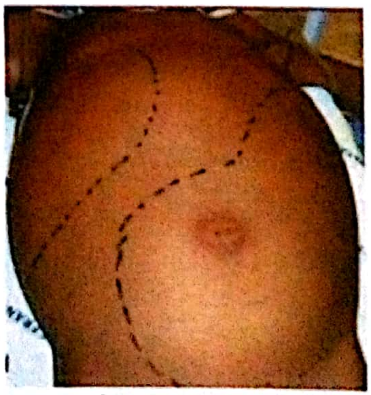
4. **Increased size of the vascular space**
   - Budd-Chiari syndrome
   - Hepatic veno-occlusive disease
   - Right-sided heart failure
   - Constrictive pericarditis
   - Restrictive cardiomyopathy

5. **Increased size of biliary space**
   - Biliary obstruction: biliary atresia
   - Caroli disease
   - Congenital hepatic fibrosis

Causes of hepatosplenomegaly

1. **Neonatal period and early infancy**: enumerate causes of cholestasis.
2. **Late infancy and early childhood**
   - Chronic hemolytic anemia (Mediterranean): spleen is enlarged more.
   - Metabolic disease: Gaucher disease, Niemann Pick disease and others.
   - Malignancy: acute leukemia: anemia, purpura and hepatosplenomegaly.

3. **Late childhood**
   - Chronic hepatitis and posthepatitic cirrhosis.
   - Metabolic: Wilson disease.
   - Bilharziasis.



Gaucher disease

Diarrhea

Definition

Increase in stool frequency and fluidity from the normal habit.

1. **Acute diarrhea : less than 2 weeks**
2. **Persistent diarrhea: more than 2 weeks**
3. **Chronic diarrhea: more than 1 month**

Etiology

Acute diarrhea: less than 2 weeks

1. **Infective diarrhea (gastroenteritis): the commonest cause of diarrhea**
   - **Bacterial (commoner in summer and more serious)**
     - Shigella.
     - Salmonella.
     - E coli.
     - Campylobacter jejuni
     - Yersinia enterocolitica.
     - Staph. aureus.
     - Cholera (severe diarrhea in epidemic)
   - **Viral (commoner in winter and less severe)**
     - Rota virus
   - **Parasitic (usually not severe)**
     - Entamoeba histolytica.
     - Giardia lamblia.

2. **Non infective diarrhea**
   - Dietetic error: overfeeding, irregular feeding or unsuitable food for age.
   - Drug induced: antibiotics (oral ampicillin).
   - Diseases outside GIT (parenteral diarrhea): respiratory or urinary tract infection.

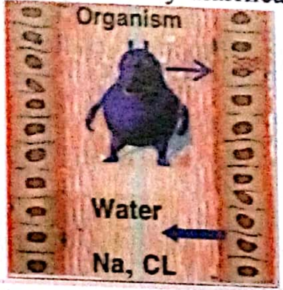
Persistent diarrhea: more than 2 weeks Page: 144

Chronic diarrhea: more than 1 month

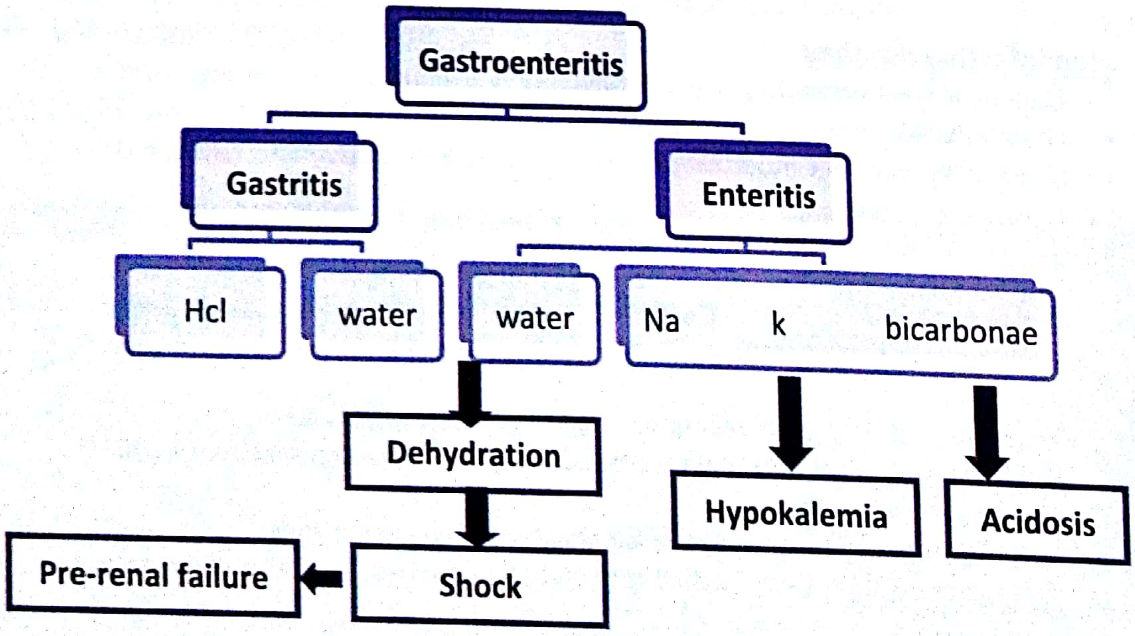
1. Chronic infection: tuberculosis
2. Malabsorption:
   - Cystic fibrosis: autosomal recessive – recurrent chest infections
   - Celiac disease: small intestinal mucosal damage due to gluten sensitivity, gluten protein is found in wheat
   - Cholestasis enumerate causes) due fat malabsorption (steatorrhea)
   - Others: immunodeficiency –inflammatory bowel disease- short bowel syndrome

Gastroenteritis (infective diarrhea)

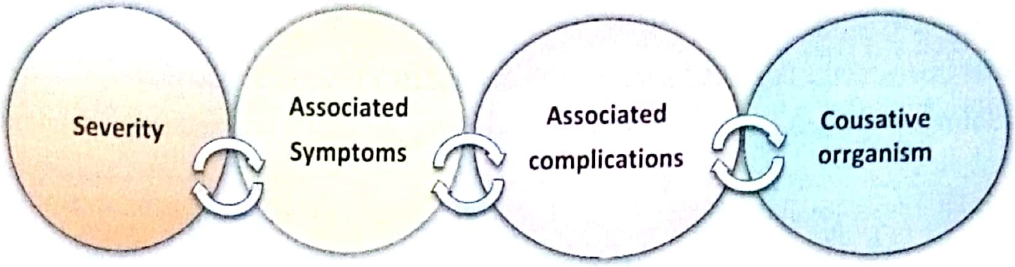
Pathophysiology

Enterotoxigenic diarrhea	Enteroinvasive diarrhea
Organisms adhere to the intestinal cells without invasion and secrete toxins that produce metabolic changes in the cell resulting in:- . Impaired absorption of Na^+ and Cl^-. . Secretion of chloride and large amounts of water. (secretory diarrhea) 	Organisms invade the intestinal cells resulting in inflammation, exudation of serum and blood and impairment of absorption. (malabsorptive diarrhea).
Stool containing large amount of fluids and electrolytes	Stool contains mucous, blood, and pus due to inflammation
Examples Cholera, E. coli.(enterotoxigenic strain) and staphylococci.	Shigella, E.coli. (enteroinvasive strain) cambylobacter, yersenia and salmonella.
Organisms within or on the surface of intestinal cells are quickly shed into the lumen as the epithelium undergoes constant shedding (life span of intestinal cells is 5-7 days), thus *these infections are self-limited* and no need for *antibiotic* therapy.	

Biochemical changes in severe gastroenteritis



Clinical diagnosis of gastroenteritis should include the following



The severity of acute diarrhea

1. **Number of motions**
   - Mild: 4-5 times/ day.
   - Moderate: 6-10 times/day
   - Severe: more than 10 times / day.
2. **Nature of motions**
   - Bloody, watery or loose stools according to the organism and severity.

The severity of associated symptoms

1. **Fever**: high fever with bacterial infections.
2. **Vomiting**: may be absent, mild, severe and persistent.

The presence of complications (possible in severe cases)

1. **Dehydration** → hypovolemic shock
   - It is the most common and most serious complication of gastroenteritis.
   - The degree (mild, moderate or severe) and type (isotonic, hypotonic or hypertonic) depend on the amount of fluid lost and the amount received by the child.
   - Manifestations in general are: sunken eyes, dry tongue, lost skin turgor.
2. **Hypovolemic shock**
   - Tachycardia, hypotension and poor perfusion (peripheral coldness and cyanosis)
3. **Acute renal failure**: oliguria or anuria and acidosis.
4. **Metabolic acidosis** → deep rapid respiration.
5. **Hypokalemia:** K less than 3.5 mEq/L →abdominal distention (hypotonia of muscles).
6. **Hypocalcemia** : convulsion or tetany

Other complications

1. **Convulsions**: due to fever, toxins, electrolyte disturbances (hyponatremia or hypernatremia or hypocalcemia) and intracranial hemorrhage.
2. **Bleeding**: due to disseminated intravascular coagulation or hypoprothrombinemia.
3. **Persistence of diarrhea**.
4. **Malnutrition** (marasmus or kwashiorkor).

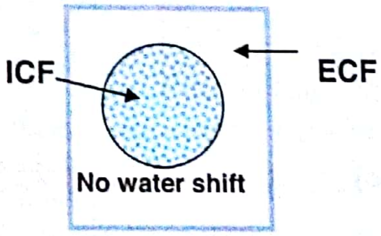
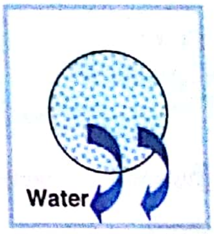
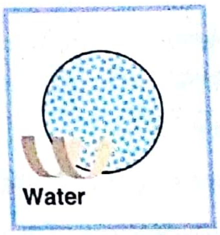
The possible causative organism (through inspection of the stool)

1. **Watery diarrhea**
   - Bacterial: E –coli (enterotoxigenic), Cholera and staphylococci.
   - Viral: Rota virus.
   - Parasitic: Giardia.
2. **Bloody diarrhea (dysentery)**
   - Bacterial: Shigella, Campylobacter, E coli(enteroinvasive), Yersinia
   - Parasitic: Entamoeba histolytica

Dehydration

Definition

Loss of extracellular fluid **(ECF)**, the intracellular fluid **(ICF)** may suffer secondarily.

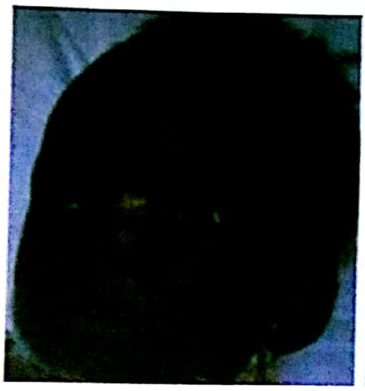
Isonatremic (isotonic)	Hypernatremic(hypertonic)	Hyonatremic (hypotonic)
Incidence 75 %	15%	10%
Pathophysiology Water and electrolytes are lost in the same proportion as in ECF ↓ . Isotonic ECF. . No movement of water between ICF and ECF. ↓ . No change in cellular hydration	Water loss more than electrolytes loss. ↓ . Hypertonic ECF. .Water passes from cells to ECF. ↓ . Cellular dehydration . ECF is not markedly reduced	lectrolytes loss more than water loss ↓ . Hypotonic ECF. . Water passes from ECF to cells. ↓ . Cellular edema . Marked reduction in EC.F
 Isotonic ECF	 Hypertonic ECF	 Hypotonic ECF
Etiology . Acute gastroenteritis	. Severe vomiting . Diabetic ketosis . High fever or hot environment	. Prolonged diarrhea
Clinical picture **1- Manifestations of reduced E.C.F volume** ↓↓ . Skin turgor: Poor . Fontanel: depressed (moderate) . Eye ball: sunken(moderate)	**1- Manifestations of reduced E.C.F volume** ↓ . Fair . Depressed(mild) . Sunken(mild)	**1- Manifestations of reduced E.C.F volume** ↓↓↓ . Very poor . Depressed(marked) . Sunken(marked)
	2-Manifestations of cellular dehydration . Tongue: very dry . CNS : irritability up to convulsions)	**2- Manifestations of cellular edema** . Tongue: moist . CNS: lethargy up to coma
Serum sodium Normal:130-150 mEq/L	High :above 150 mEq/L	Below 130 mEq/L

- **Diarrhea is much serious during infancy as infants are more prone to dehydration**
  1. **Greater surface area to weight ratio**, leading to greater insensible water losses.
  2. **Inability to gain access** to fluids when thirsty.
  3. **Higher basal fluid requirements** (100-120 ml/kg per day, i.e. 10-12% of body weight).

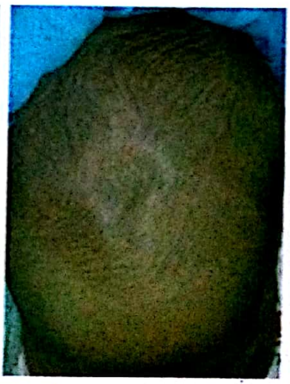
Clinical assessment of dehydration (clinical grading)

	Mild	Moderate	Severe
Body weight loss	4%	5-9 %	≥10%
Mental state	Normal, alert	Restless or fatigued, irritable	Apathetic, lethargic, unconscious
Radial pulse (Rate and quality)	Normal	Normal or rapid	Rapid, thready, may be impalpable
Blood pressure	Normal	Normal or low	Low
Breathing	Normal	Deep, may be rapid	Deep and rapid
Anterior fontanelle	Normal	Slightly sunken	Deeply sunken
Eyes	Normal+	Slightly sunken	Deeply sunken
Skin turgor	Immediate recoil	Recoil < 2 seconds	Recoil > 2 seconds
Mucous membranes	Moist tongue	Moist tongue	Very dry tongue(woody)
Tears	Present	Normal /Reduced	Absent
Capillary refill time	Normal	Prolonged (> 2 seconds)	Minimal
Extremities	Normal (warm)	Cold	cold, cyanotic , mottled

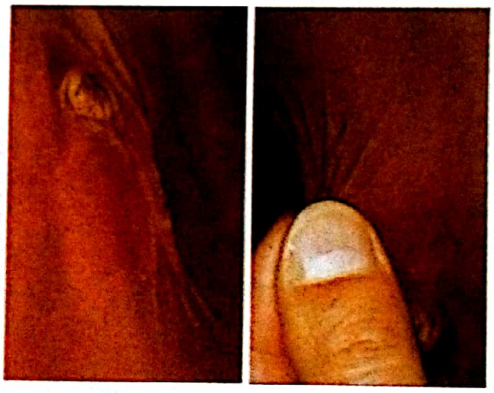
N.B. Each 1% weight loss due to dehydration requires 10 ml/kg fluid to correct it



Sunken eyes



Depressed Fontanelle



Lost skin turgor

Investigations of gastroenteritis

Investigations to determine the causative organism

1. Stool analysis (detection of parasites) and culture (detection of bacteria and viruses).

Investigations in complicated cases e.g. in dehydration.

1. Serum electrolytes (sodium , potassium and calcium)
   - **Sodium**: being the most prevalent electrolyte in ECF, its level is an accurate guide for tonicity of ECF and determination of type of dehydration
     - Isotonic dehydration: level between 130 - 150 mEq/ L
     - Hypotonic dehydration: less than 130 mEq/L
     - Hypertonic dehydration: more than 150 mEq/L
   - **Potassium** : normal level 3.5 -5 mEq/L
   - **Calcium**: normal level 9-11 mg/dl
2. Kidney functions (urea and creatinine) if suspecting prerenal failure.
3. Blood gasses for detection of metabolic acidosis.
4. Platelet count, prothrombin time and fibrin degradation if suspecting DIC.
5. CBC and CRP: leukocytosis and elevated CRP with bacterial infections.

Home management: mild to moderate dehydration

1. Oral Rehydration Solution (ORS)

It is the most important item to prevent and treat water and electrolyte disturbances.

- **Principle**

  Glucose - facilitated Na absorption mechanism :

  Glucose enhances sodium and water absorption, not as a calorie source.

- **Composition (WHO solution) , available as packets to be dissolved in water**

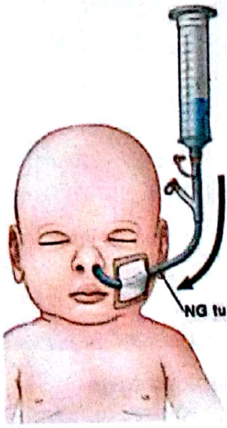
NaCl	3.5 gm
Na citrate	2.5 gm
K CL	1.5 gm
Glucose:	20 gm

when this preparation is dissolved in one liter of water, it will give the following ionic concentration:

Na	90 mEq/L
Cl	80 mEq/L
Citrate	30 mEq/L
K	20 mEq/L
Glucose:	110 mmol/L

N.B

- The ORS available in the market is reconstituted in 200 ml of water(not in 1 liter)
- The classic ORS containing 90mEq/L sodium may result in hypernatremia in some cases. Other ORSs are now made containing less Na (40-70 mEq/L).



- **Indications** : all cases with mild and moderate of dehydration.
- **Dose**
  - 50 -100 ml/kg over 4- 6 hours, according to the degree of dehydration (mild or moderate). The thirst mechanism is effective in regulating the amount of fluids received
  - Replace the ongoing losses: 10 ml/kg of ORS is given for each motion

- **Method of administration**
  - Spoon and cup every 1 to 2 minutes (to decrease vomiting which is frequent with start of therapy)
  - Bottle
  - Nasogastric tube may be used in case of:
    - Refusal of ORS. (uncooperative baby)
    - Unconscious dehydrated cases.
    - Uncooperative mother.

- **Advantages**
  - Safe and cheap.
  - Suitable for all ages
  - All types of diarrhea (bacterial or viral)
  - All types of dehydration provided that Na level is between 115-165 mEq/L.

2. Feeding

- It should start shortly after starting ORS. Delayed feeding will delay repair of intestinal cells → persistence of diarrhea.
- **In breast fed infants**: breast milk is given gradually according to the child's tolerance.
- **In formula fed infants**: start with diluted formula (1/4 strength) and increase the concentration gradually according to the tolerance.
- **In older children**: gradual introduction of foods starting with boiled vegetables, fruits

3. Treatment of infection

- Gastroenteritis is self-limited infection; organisms are cleared from the intestine within few days. Antibiotics can kill the normal intestinal flora and impair the function of intestinal cells→ persistent diarrhea.
- Antibiotics
  - ➢ Oral amoxicillin (50mg/kg/day) or IM antibiotics e.g. aminoglycosides in:
    - Severe systemic manifestations after shigella infection.
    - Severe systemic manifestations as high fever or toxemia.
  - ➢ Oral Metronidazole for 7 days in Giardia (25mg/kg/day) and Entamoeba (50 mg/kg/day)

4. Symptomatic treatment

- **Vomiting**: antiemetic e.g. metoclopramide
- **Fever**: antipyretics.e.g. Paracetamol.
- **Diarrhea**: no scientific role for the use of antidiarrheal drugs.

Hospital management for severe dehydration or complicated cases.

Indications

1. Deterioration of the patient during home management.
2. Dehydration or shock
3. Severe persistent vomiting (even with mild or moderate dehydration)
4. The presence of complications e.g. metabolic acidosis, septicemia or bleeding

Intravenous rehydration

1. **Shock therapy :(over 1 hour)**
   - Lactated ringer (or normal saline) solution 20 ml/kg .May be repeated in severe cases
2. **Deficit therapy (over 8 hours)**
   - Glucose 5 % and saline in a ratio (1 : 1)
     - 40 ml/kg in mild dehydration
     - 80 ml/kg in moderate dehydration
     - 120 ml/kg in severe dehydration.
   - In hypernatremic dehydration
     Slow correction and **under correction** are important to avoid brain edema. Only 60% of the deficit is given.
3. **Maintenance therapy: (over 16 hours)**
   - Glucose 5 % and saline in the ratio (4:1)
     - 100 ml/Kg for the first 10 kg
     - 50 ml/kg for each kg from 11-20kg
     - 20 ml/kg for each kg above 20kg
   - In hypernatremic dehydration **slow** correction and **under correction** are important to avoid brain edema. Only 70% of the maintenance is given.

4. **Fluid management in the next 24 hours**
    - Patient still dehydrated: calculate deficit and maintenance + the expected ongoing losses.
    - Patient fully hydrated but diarrhea still severe: calculate the maintenance + the expected ongoing losses.
    - Patient fully hydrated and diarrhea improve: 50% of maintenance is given IV and 50% is given as ORS or simple fluid and food

➢ **Potassium therapy**

Potassium chloride solution (15%) **is added** (never IV shots) to deficit and maintenance therapy: 1ml for each 100 ml solution to correct hypokalemia

Treatment of complications

1. Metabolic acidosis→ 4ml/kg of sodium bicarbonate solution 5%, slow IV.
2. Convulsions→ 0.5 mg/kg diazepam, slow IV.
3. Hypocalcemia if present→ 1ml /kg of calcium gluconate 10%, slow IV
4. Bleeding→ blood transfusion
5. Septicemia: combined parenteral antibiotics
6. Shock: in addition to IV fluids , inotropic therapy in severe cases

Persistent Diarrhea

Definition

Diarrhea persists for more than 2 weeks.

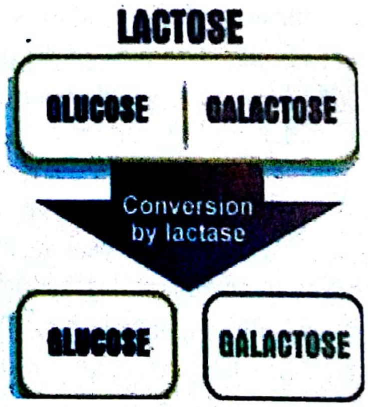
Incidence

5-20% of cases suffering from acute diarrhea become persistent.

Etiology

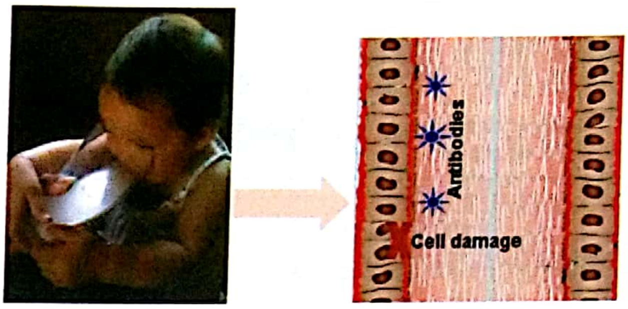
1. Sugar intolerance (lactose intolerance)

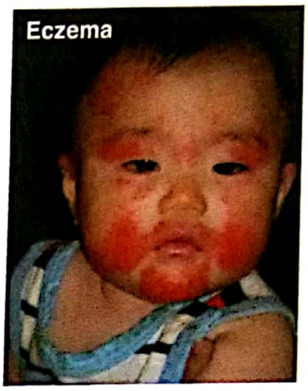
- **Pathogenesis**
  Infection→destruction of brush border of intestinal villi where disaccharidases are present → loss of disaccharidases (lactase deficiency followed by sucrose then maltase deficiency) → malabsorption of sugar→ osmotic diarrhea. Fermentation of sugars by the intestinal flora→ production of organic acids which induce diarrhea
- **Diagnosis**: Watery stool contains sugar and acids.
- **Treatment : lactose free formula for several days**



2. Cow's milk protein allergy

- **Pathogenesis**
  The intestine is impermeable to protein after the early days of life. Damage of the intestinal wall by diarrhea can trigger intestinal allergy → continuous damage of intestinal cells and continuation of diarrhea.
- **Diagnosis**
  - Stools contain mucous and blood (occult or frank blood)
  - Elimination of cow's milk protein from diet→diarrhea improves.
- **Treatment**
  - Soy protein based formula or hypo allergic (protein hydrolysate) formula





3. Bacterial overgrowth in upper small intestine

- **Pathogenesis**
  - After acute diarrhea, colonic bacteria (fecal bacteria: anaerobes and E-coli) ascend and invade the upper small intestine which is sterile under normal condition→
  - Mucosal damage occurs by direct bacterial invasion or toxin production→ persistence of diarrhea.
- **Diagnosis** stool culture

4. Persistent infection by Giardia lamblia and Entamoeba histolytica infections

Pathogenesis of persistent diarrhea: Why diarrhea persists?

The continuation of diarrhea and the presence of offending agents (disaccharides, cow's milk protein and bacteria) will lead to continuous intestinal mucosal injury and atrophy in prolonged cases → impaired digestion and absorption → persistence of diarrhea →malnutrition.

Complications

1. Malnutrition
2. Increased susceptibility to infections

Treatment

Proper nutritional management that should continue for a long time after diarrhea stops to give time for regeneration of intestinal mucosa:-

1. Removal of the offending agent from diet e.g. lactose or cow milk protein
2. Fat given as medium chain triglycerides to facilitate absorption
3. Vitamins especially vitamin A and trace elements like zinc

Vomiting

Definition

Forceful expulsion of gastric contents through the mouth

Etiology

Neonatal

- **Vomiting in doing well baby**
- **Vomiting in Sick baby**
  1. Medical
  2. Surgical : non bile stained Or bile stained

Infancy and childhood

- **Medical**
- **Surgical**

Neonatal Vomiting

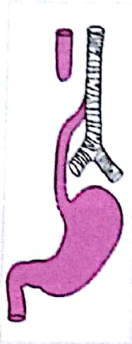
Vomiting in doing well baby

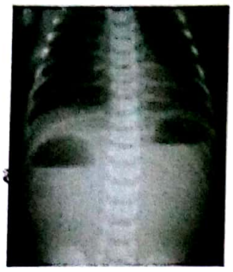
- **Milk**
  1. Overfeeding and irregular feeding.
  2. Gastro**E**sophageal **R**eflux: (vomiting after the first week and persist).
- **Mucoid**
  1. Amniotic gastritis (during the first few days).
- **Blood stained**
  1. Hemorrhagic disease of the newborn (during the first few days).
  2. Swallowed maternal blood (during the first few days).

Vomiting in sick baby

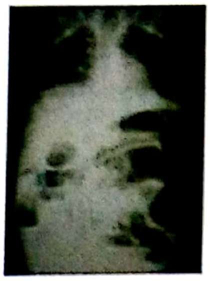
- **Medical**
  1. **Infections**
     - Septicemia and meningitis
     - Abdominal: gastroenteritis and urinary tract infections.
  2. **Increased intracranial tension e.g. intracranial hemorrhage**
  3. **Metabolic disorders**
     - Galactosemia.
     - Congenital adrenal hyperplasia

- **Surgical**
  1. **Non bile stained**
     - Esophageal atresia with tracheoesophageal fistula: vomiting with the first feed
     - Congenital hypertrophic pyloric stenosis (vomiting after 2-3 weeks and becomes projectile)
  2. **Bile stained:** intestinal obstruction e.g. duodenal atresia, volvulus or Hirschsprung's disease.

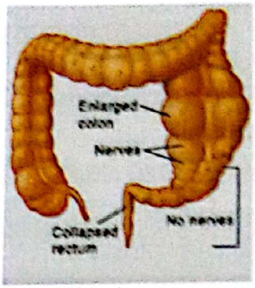




Double bubble sign
Duodenal atresia



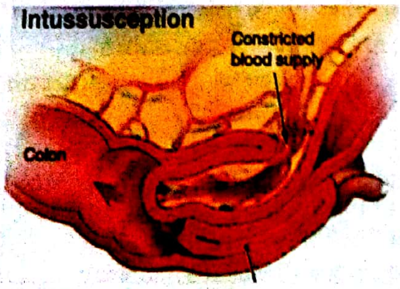
Multiple air fluid levels
Intestinal obstruction

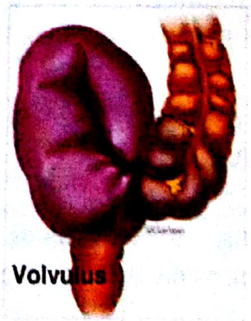


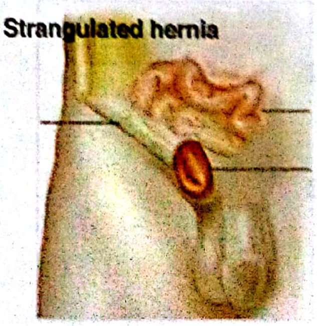
Hirschsprung

Vomiting in infancy and childhood

- **Medical**
  1. **Dietetic errors**
     - Overfeeding
     - Excess fat or carbohydrate
     - Irregular feeding or tight binder
  2. **Infections**
     - Abdominal: gastroenteritis, hepatitis, urinary tract infections.
     - Respiratory: otitis media, acute tonsillitis, acute bronchitis, pneumonia.
     - CNS infections: meningitis, encephalitis and brain abscess (increased tension)
  3. **Increased intracranial tension. e.g. brain tumors**
  4. **Metabolic disorders.**
     - Diabetic ketosis (excretion of ketone bodies in the stomach)
     - Hypervitaminosis D
     - Disorders of amino acid metabolism e.g. aminoacidopathy
     - Renal failure (uremic gastritis)
- **Surgical**
  1. Intestinal obstruction. e.g. intussusception, volvulus or strangulated inguinal hernia







Treatment of vomiting

1. Treatment of the original cause
2. Antiemetic drugs: Metoclopramide : 0.5mg or Domperidone : 1 mg/kg /day

Gastroesophageal reflux

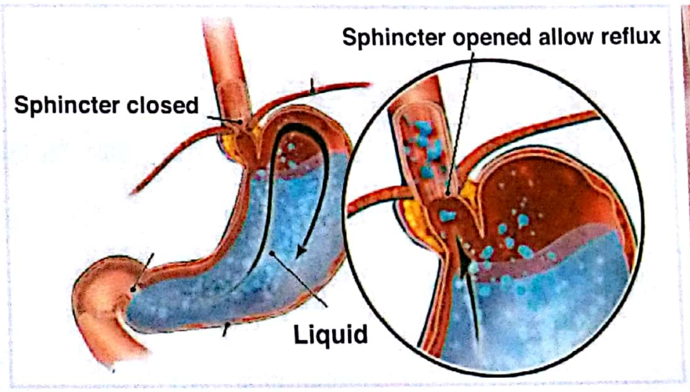
Definition

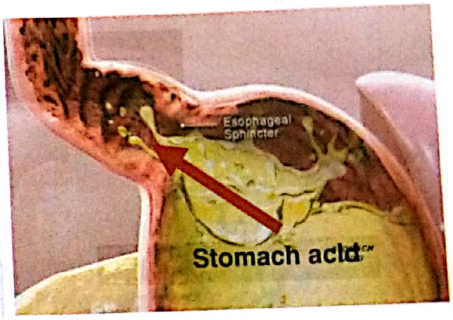
It is a reflux (retrograde passage) of gastric contents into the esophagus.

Etiology

1. Functional immaturity of the lower esophageal sphincter leading to episodes of abnormal relaxation.
2. Short intra-abdominal length of esophagus. Sliding hiatus hernia may be present in some infants

➢ Reflux may be problematic in
  - Children with cerebral palsy or other neurodevelopmental disorders
  - Preterm infants who develop bronchopulmonary dysplasia
  - Following surgery for esophageal atresia or diaphragmatic hernia





Clinical manifestations

1. Asymptomatic in many cases
2. Symptoms (vomiting and regurgitation) are common during the first year of life.
3. By 12 months of age, nearly all symptomatic reflux will have resolved spontaneously, due to a combination of maturation of the lower esophageal sphincter, assumption of an upright posture and more solids in the diet.

Complications in severe reflux

1. Gastrointestinal

- Excessive vomiting and regurgitation → Failure to thrive.
- Esophagitis: Pain and irritability – Bleeding and may be iron deficiency anemia.
- Esophageal stricture from severe esophagitis.

2. Respiratory

- Aspiration →recurrent cough and wheezes.
- Apnea in preterm infant.

3. Others

- Apparent life threatening events or sudden infant death syndrome
- Abnormal (Dystonic) movement of the head and neck (Sandifer'syndrome)

Investigations (Not needed in mild typical cases)

1. 24 hours esophageal pH monitoring: the best diagnostic test
2. Upper GIT endoscopy in suspected esophagitis
3. Contrast study of the upper gastrointestinal tract.

pH monitoring

Esophagitis

Treatment

Mild cases

1. Positioning: 30° head up prone position after meals.
2. Thickening of feeds (with cereals).

Sever cases: drugs

1. Increase gastric emptying e.g. domperidone
2. Proton pump inhibitors e.g. omeprazole to reduce oesophagitis

Positioning

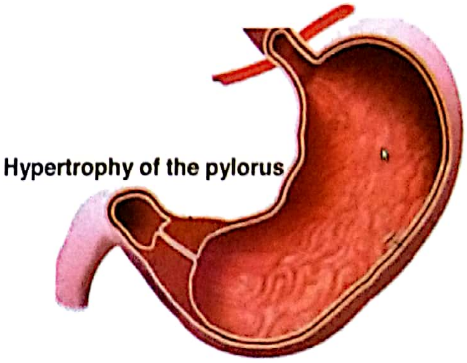
Surgical treatment

1. Refractory cases
2. Cases with esophageal stricture or recurrent aspiration

Congenital Hypertrophic Pyloric Stenosis

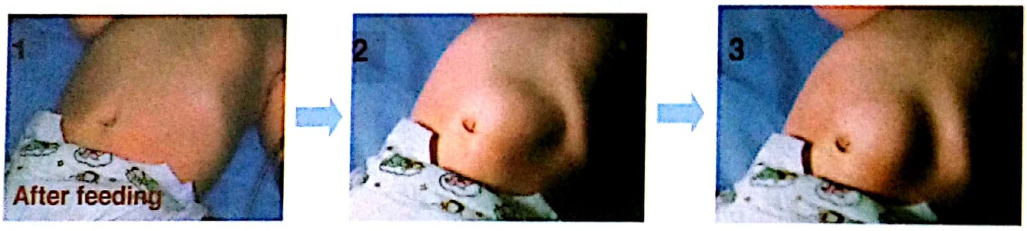
Etiology

Multifactorial: genetic and environmental factors.



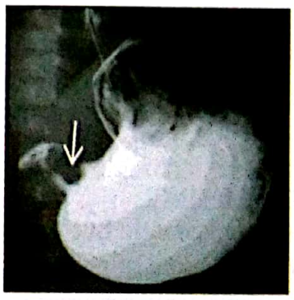
Clinical picture

1. **Type of the infant**
   - More common in boys (boys to girls 4:1).
   - More common in the first borne boy.
   - Positive maternal family history.
2. **Vomiting**
   - Onset : between 2-7 weeks of age
   - Characters: projectile, not bile stained, increase in frequency and severity with time.
3. **Constant hunger** even after vomiting.
4. **Weight loss** or poor weight gain if presentation is delayed.
5. **Olive like mass** in the right upper quadrant + **Gastric peristalsis** on test feed.



Investigations

1. Low serum potassium (hypokalemia) with alkalosis (vomiting acid stomach contents).
2. Abdominal ultrasound confirms the diagnosis.
3. Contrast upper GIT studies



. Dilated stomach
. The narrow pyloric canal appears as single line of barium: string sign

Treatment

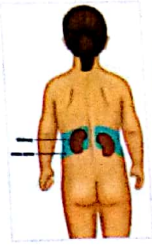
1. Correct any fluids and electrolytes disturbances (especially chloride and potassium).
2. Surgical correction: pyloromyotomy.
3. Postoperative: the child can be fed the next day and discharged within 2-3 days of surgery.

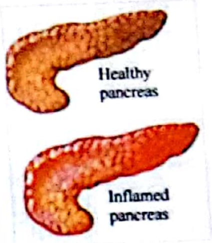
Acute abdominal pain

Acute abdominal infections

It is the commonest cause of acute abdominal pain, abdominal examination can help in differentiation based on the site of pain and tenderness.

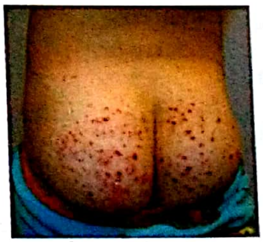
1. Early gastroenteritis (epigastric pain).
2. Early hepatitis (right hypochondrial pain).
3. Acute pyelonephritis (loin pain).
4. Acute **Pancreatitis** (epigastric pain).
5. Acute peritonitis(diffuse abdominal pain).
6. Acute appendicitis



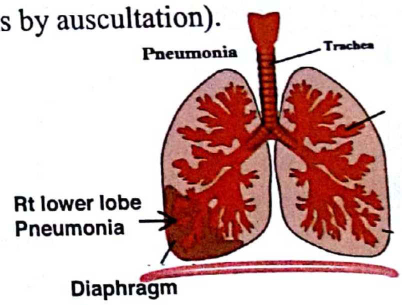


Acute abdominal disorders

1. Henoch Schonlein purpura (rash, arthritis and nephritis).
2. Diabetic ketoacidosis (acidosis, dehydration, polyuria).
3. Right lower lobe pneumonia (fever, cough and crepitations by auscultation).
4. Lead poisoning.
5. Drug intoxication
6. Acute rheumatic fever

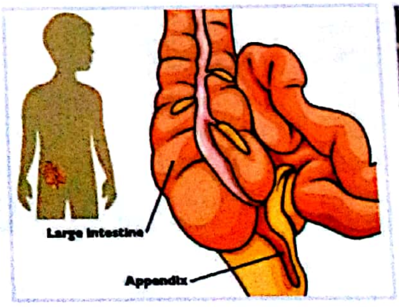


Henoch Schonlein purpura



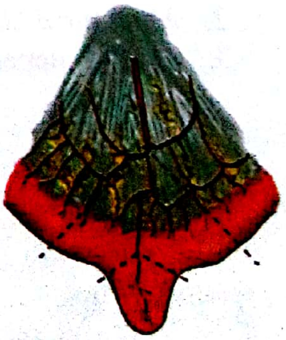
Acute surgical disorders

1. Acute appendicitis: the commonest
2. Obstructed inguinal hernia.
3. Intussusception.
4. Volvulus.
5. Masses e.g. impacted fecal mass or Round worm (Ascaris) mass
6. Inflamed Meckel's diverticulum.



Meckel's diverticulum

Meckel's Diverticulum



Pathology

- It is an ileal remnant of the vitellointestinal duct.
- Contains ectopic gastric mucosa or pancreatic tissue.

Incidence: 2% of individuals.

Clinical picture

- Asymptomatic but they may present with severe rectal bleeding.
- Other forms of presentation: Intussusception, volvulus, or diverticulitis (mimics appendicitis).

Investigations

- Technetium scan: it demonstrates increased uptake by ectopic gastric mucosa in 70% of cases.

Treatment: surgical resection

Recurrent Abdominal Pain

I- Non organic recurrent abdominal pain **(Dysfunctional or psychogenic)**	**2- Organic recurrent abdominal pain**
A very common problem in pediatric patients, occurring in 10 15% of cases	
Incidence . 90% **Etiology**. **Unknown mechanism.** No structural or mucosal abnormality is found. One of the following factors may be responsible 1. Stress → change in GIT motility→ pain . Family problems: parent conflict, loss of one parent, delivery of new sibling . School phobias (pain may be limited to school days) 2. To gain more love and sympathy. 3. Imitation of an adult with recurrent pain	10% **Etiology** ▪ **Common causes** 1. Parasitic infestations: giardiasis, amoebiasis and ascariasis (not oxyurius) 2. Chronic constipation 3. Dietetic: lactose intolerance, bad selection of food. 4. Drugs ▪ **Uncommon causes** 1. Sickle cell anemia(vasooclussive crisis) 2. Stones: renal 3. Peptic *ulcer* 4. *Ulcer*ative colitis 5. Chronic hepatitis 6. Familial Mediterranean fever Serious malignancies don't present with recurrent abdominal pain
Clinical picture: **1. Pain : SSSS** . Site: periumbilical It can be located properly by the child even with one finger. 	**Clinical picture** **1. Pain** Site: away from the umbilicus The site may suggest the cause . Renal stones: loin pain . Chronic hepatitis: right hypochondrium. . Peptic ulcer: epigastric. . Constipation: left lower quadrant
. Severity: not severe, not interfering with activity. Parent usually come to complaint after several weeks of onset	. Severity: may be severe e.g. renal stones and may interfere with activity
. Style (type) : vague	. Style : variable e.g. colicky with renal stones
. Spontaneously subside within less than 20 minutes.	May persist for more time.

2. **Associated complaints** : Absent	2. **Associated complaints** : Present and can help in reaching diagnosis e.g. - Recurrent episodes of abdominal pain and fever (periodic peritonitis) - Hematuria and dysuria: renal stones - Bleeding per rectum: ulcerative colitis
3. **General examination** Normal	3. **General examination** The child may appear anemic or wasted
4. **Abdominal examination** **Free**	3. **Abdominal examination** May reveal focal tenderness or enlarged organs
Investigations Routine investigations are normal e.g. Urine, stool analysis, blood count and x ray a	**Investigations** . Routine investigations may be abnormal. . Other investigations e.g. ultrasonography endoscopy or intravenous pyelography may be needed according to the suspected diagnosis
Treatment Reassurance	**Treatment** Treatment of the cause

Abdominal masses

Acute masses

1. **Intussusception**
2. **Fecal masse**
3. **Distended bladder**

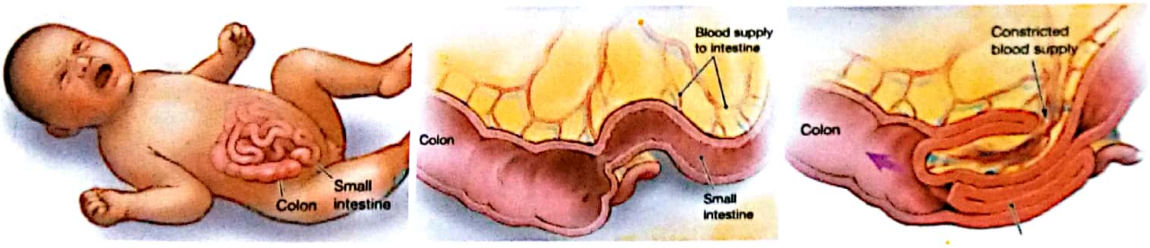
Chronic masses

1 **Hepatosplenomegaly**
2. **Suprarenal masses**
3. **Renal masses**
4. **Pancreatic masses**
5. **Intestinal masses**
6. **Retroperitoneal masses**
7. **Female genital tract masses**

Intussusception

Definition

It is invagination of proximal bowel into a distal segment, most commonly affects the ileum passing into the caecum and colon through the ileocaecal valve



Incidence

The most common cause of acute intestinal obstruction between 3 months and 3 years with a peak incidence around the age of 6 months.

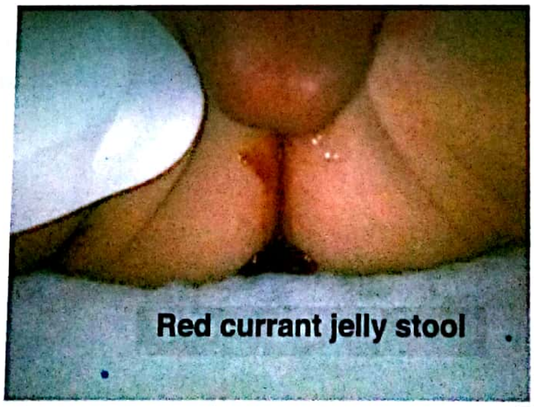
Etiology

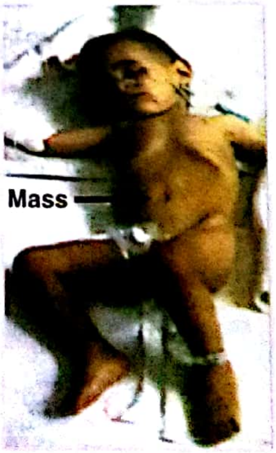
1. Unknown in most cases.
2. It may complicate gastroenteritis -viral infection leading to enlargement of Pyer's patches.
3. Meckel's diverticulum or chronic polyps may be a precipitating factor in children more than 2 year old

Clinical picture

History

1. Abdominal pain: sudden, severe, colicky and paroxysmal, accompanied with loud crying. During the episodes the child become pale and draws up his legs.
2. Vomiting is more frequent early.
3. Passage of stool containing blood and mucus (red currant jelly stool) within 12-24 hours of pain. At this point the condition may be misdiagnosed as gastroenteritis with bloody diarrhea; however absence of fever with sudden pain in otherwise normal infant can differentiate between both conditions.



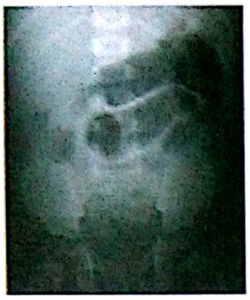


Examination

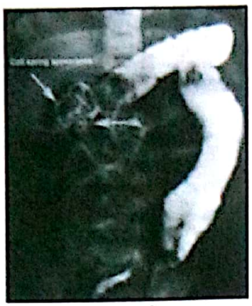
1. Abdominal examination : **sausage-shaped** mass in **the right upper quadrant** in 70% of cases, better felt by bimanual abdominal and rectal examination.
2. Rectal examination: bloody mucus on the finger.
3. If the condition is not diagnosed early during the first day or two, the condition will pass into shock like state with bile stained vomitus, abdominal distention and high fever.

Investigations

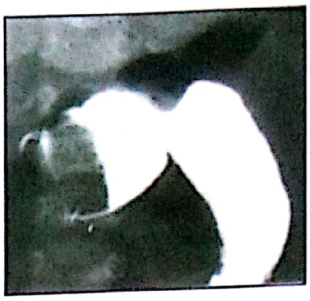
1. Abdominal ultrasound.
2. Plain X: distended small bowel and absence of gas in the distal colon or rectum
3. X ray with contrast of the lower GIT will show coli spring appearance or claw sign



Plain x ray



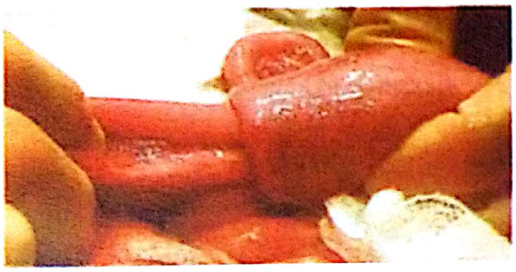
Coil spring



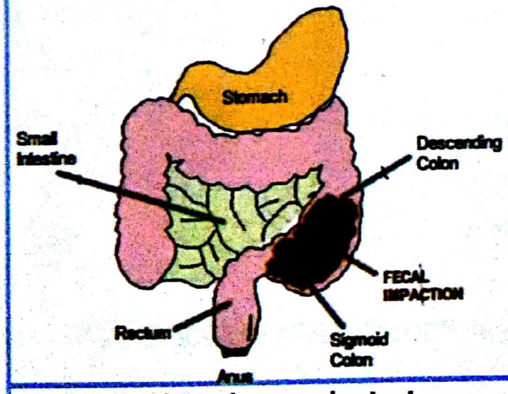
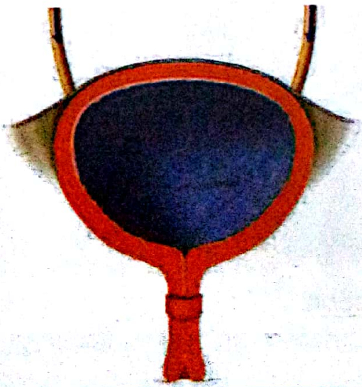
Claw sign

Treatment

1. Early cases: simple reduction by rectal air insufflation
2. Late cases: resection anastomosis is needed.
3. Correction of fluids and electrolytes imbalance if present



Intussusception at operation showing the ileum entering the caecum. The surgeon is squeezing the colon to reduce the intussusception.

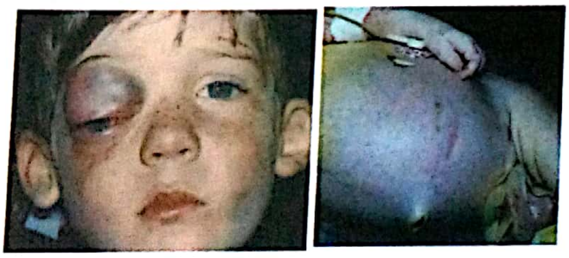
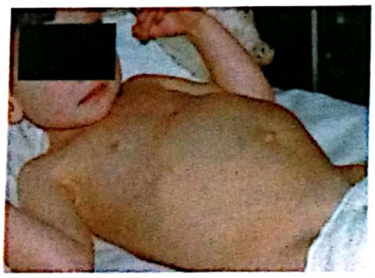
<table>
<tr><th>2. Fecal mass</th><th>3. Bladder mass (distended bladder)</th></tr>
<tr><td>History
Constipation and acute abdominal pain</td><td>History
Urine retention and acute abdominal pain</td></tr>
<tr><td>Abdominal examination
One or more sausage shaped masses in the left lower quadrant
 </td><td>Abdominal examination
Single Globular shaped mass in the midline at the suprapubic area , firm pressure on the mass may lead to immediate urination
</td></tr>
<tr><td colspan="2">Intussusception : the mass is single sausage shaped in the right upper quadrant</td></tr>
</table>

Chronic Abdominal masses

1. Hepatosplenomegaly

Enlargement of the liver and spleen or both is the commonest cause of abdominal mass (Mention causes of hepatosplenomegaly)

2. Renal and Suprarenal masses

Neuroblastoma	**Wilms (nephroblastoma)**
The most common and most serious masses	
Incidence . Below the age of 3 years	. Around the age of 3 years. . The most common renal neoplasm
Origin Primitive nerve cells in adrenal glands, or sympathetic chain.	Primitive renal cells in the kidney
Clinical picture:	**Clinical picture**
1. Mass	**1. Mass**
In the right or left upper quadrant.	
. Commonly crossing the midline. . Hard, with irregular or nodular surface 	. Usually doesn't cross the midline . Firm with smooth surface 
2. Associated manifestations . Hepatomegaly . Bone marrow infiltration→anemia, purpura and bony pain . Retro-orbital infiltration → proptosis	**2. Associated manifestations** . Hematuria . Hypertension . Abdominal pain
Diagnostic investigation Bone marrow examination (Reveals neuroblastoma cells in 70% of cases)	**Diagnostic investigation** CT scan abdomen and biopsy

Other renal masses

- Hydronephrosis, cystic dysplasia
- Renal artery or renal vein thrombosis
  - May cause unilateral or bilateral renal masses.
  - Other manifestations e.g. hematuria or renal failure may be present.

3. Pancreatic masses

- **Pancreatic pseudocyst**
  - The commonest pancreatic mass.
  - History of blunt trauma to the abdomen may be present.
  - Mass is epigastric.
- **Other pancreatic cysts**: Retention cyst and cystadenoma are less common.

4. Intestinal masses: mobile midabdominal masses

- Intestinal cysts: mesenteric cyst, omental cyst, duplication cysts
- Intestinal lymphoma: huge abdominal mass and ascites.
- Inflammatory masses: tuberculous mesenteric adenitis, Crohn disease.

5. Retroperitoneal masses

- Fixed abdominal mass in the upper or lower abdomen
- Arise from retroperitoneal tissue
- Examples are: teratoma, rhabdomyosarcoma, fibrosarcoma or lymphoma

6. Female genital tract masses

- Ovarian cysts and tumors should be considered in females with abdominal mass
- Uterine causes: tumors, hydrometria and hematometria
- Vaginal causes: tumors, hydrocolpos and hematocolpos

Investigations for abdominal masses

Laboratory

1. Bone marrow aspiration if suspecting neuroblastoma or lymphoma.
2. Renal function tests in bilateral renal masses.

Imaging

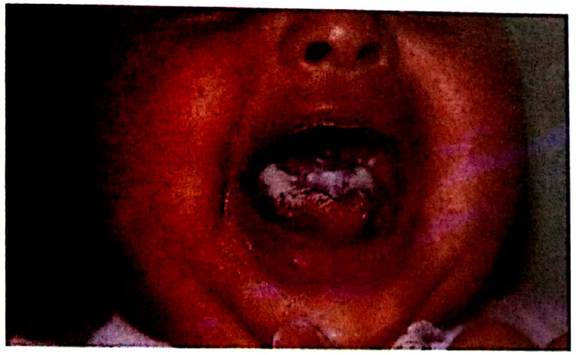
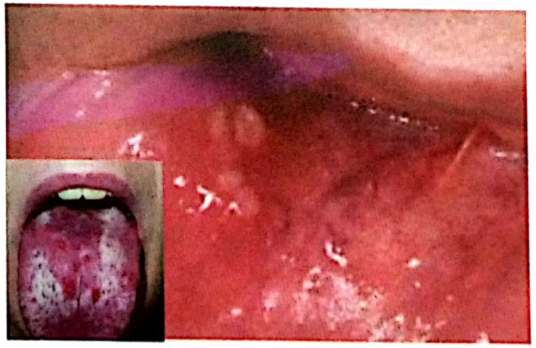
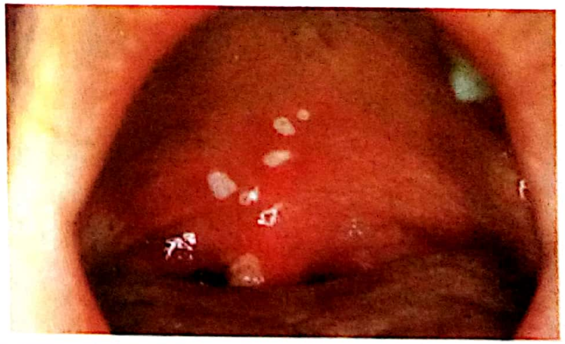
1. Ultrasonography.
2. Intravenous pyelography for cases with renal masses.
3. CT abdomen.

Biopsy

1. Laparotomy and open biopsy if malignancy is suspected

Painful Oral Lesions

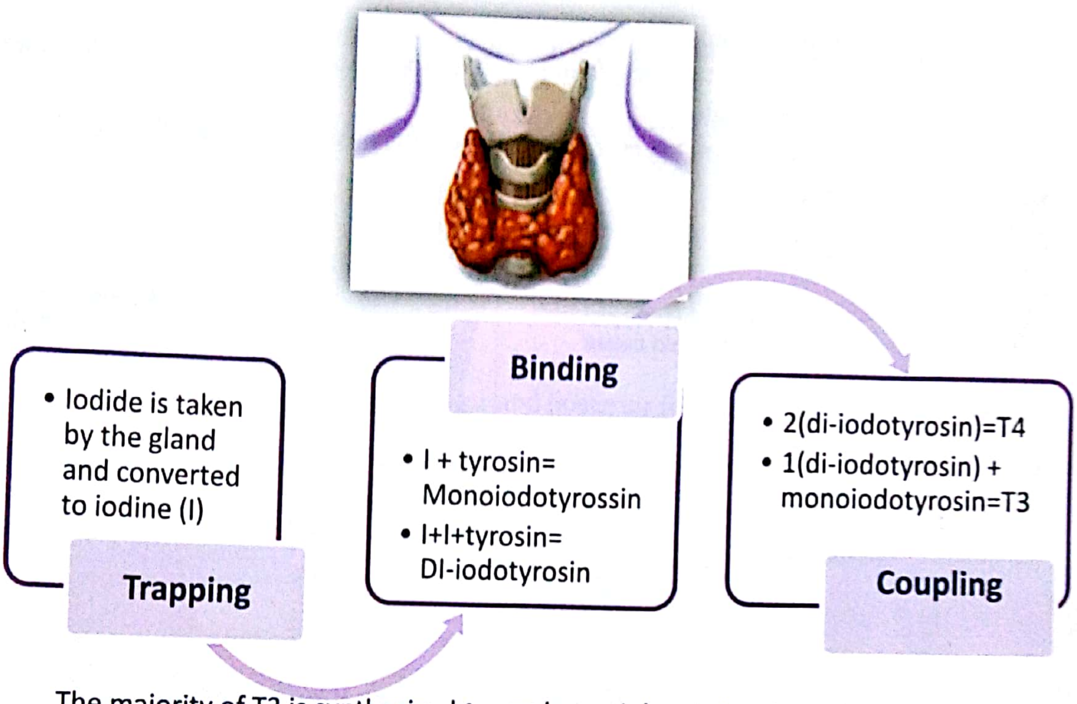
- **Stomatitis**: inflammation of the oral mucosa
- **Gingivitis**: inflammation of the gums with no or minimal affection of the oral mucosa
- **Gingivostomatitis**: inflammation of both gum and oral mucosa.

Monilial stomatitis	Herpetic gingivostomatitis	Herpangina
		
Incidence Common in neonatal period and early infancy	Most common between 1- 3 years of age It is the commonest cause of gingivitis	In children below 5 years of age
Etiology Candida albicans - In neonates infection is acquired intrapartum or from infected nipple in breast fed infant - Later on,predisposing factors are . Prolonged antibiotic therapy . Malnutrition . Immunodeficiency(T cell)	Herpes simplex virus	Coxsackie virus

Clinical picture 1. **Oral lesions** - **Site of the lesions** . Tongue (all or part of it) . Gingiva . Oral mucosa - **Nature of the lesions** . White flaky plaques, when removed leave a bright inflamed base	- **Site of the lesions** . Tongue . Gingiva . oral mucosa - **Nature of the lesions** . Small ulcers	- **Site of the lesions** . Anterior tonsillar pillars, in severe cases may involve soft palate, uvula, tonsils and posterior pharyngeal wall. - **Nature of the lesions** . Vesicles and ulcers that are small in size and few in numbers, each one is surrounded by erythematous ring.
2. **Associated pain** . Mild, may cause feeding difficulty	Severe pain with salivation and refusal of feeding.	Severe pain with sore throat and refusal of feeding.
3. **Fever** is absent	3. **Fever** is high especially in the beginning	3. **Fever** is present
Treatment . Antifungal Oral nystatin(mycostatin) or oral Miconazol (Daktarin oral gel) for 10 days.	. Symptomatic Oral analgesics and antipyretics . Antiviral agents are not indicated.	. Symptomatic
Course Persistence of oral moniliasis for more than 10 days in spite of effective therapy or frequently recurring lesions→ possible immunodeficiency (T cell function should be evaluated)	The condition subsides within 4- 8 days.	The condition usually subsides within 3-6 days

Hypothyroidism

Thyroid hormones Synthesis



Trapping

- Iodide is taken by the gland and converted to iodine (I)

Binding

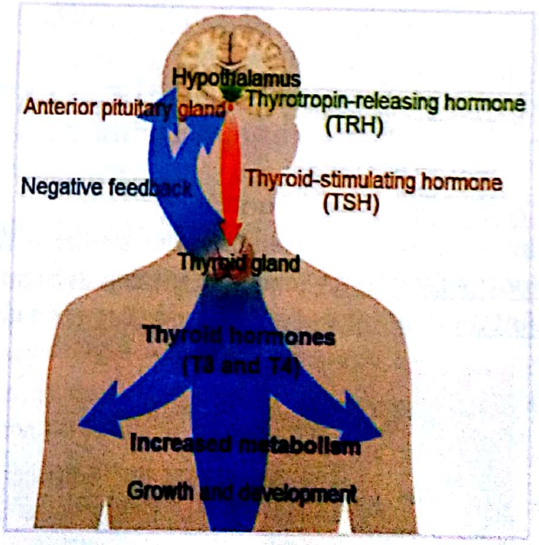
- I + tyrosin= Monoiodotyrossin
- I+I+tyrosin= DI-iodotyrosin

Coupling

- 2(di-iodotyrosin)=T4
- 1(di-iodotyrosin) + monoiodotyrosin=T3

The majority of T3 is synthesized fromT4 by peripheral deiodenation

Thyroid hormone regulation



Thyroid hormones actions

1. **Growth and development** (Brain : neurogenesis and myelination) , deficiency in early life irreversible →brain damage and mental retardation
2. **Metabolism**: stimulate oxygen consumption.
3. **C.V.S**: stimulate cardiac functions.
4. **G.I.T.**: stimulate motility.
5. **Blood**: synthesis of RBCs.
6. **Carotene** → Vitamin A

Types of hypothyroidism

1. **According to the time of onset**
   - Congenital hypothyroidism: presents early in neonatal period and early infancy
   - Acquired hypothyroidism: presents in childhood after a period of normal growth
2. **According to the site of lesion**
   - Primary hypothyroidism: thyroid gland lesion (which may be congenital or acquired):T3 and T4 are low and TSH is high.
   - Secondary hypothyroidism: pituitary or hypothalamic lesion: low TSH, T4 and T3

Primary hypothyroidism
Thyroid cause

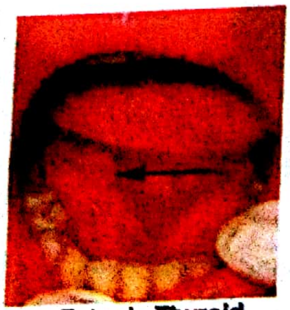
Secondary
Pituitary or hypothalamic

Etiology of primary hypothyroidism (congenital and acquired)

Congenital hypothyroidism

It is more serious because it affects the developing brain, early detection by neonatal thyroid screening is important to prevent mental retardation.

1. **Maldevelopment** of thyroid gland (nongoitrous): 75% of cases
   - Agenesis (aplasia) or dysgenesis (hypoplasia)
   - Ectopic thyroid: the gland is usually dysgeneic and located anywhere between the root of the tongue and suprasternal notch
2. **Dysmorphogenesis**(goitrous)
   Inborn errors of thyroid hormone synthesis (autosomal recessive).
3. **Iodine deficiency** (endemic goiter): in Sinai and Oasis
4. **Antenatal intake** of antithyroid drugs or radioactive iodine



Ectopic Thyroid

Endemic hypothyroidism

Acquired hypothyroidism: it is commoner but less serious and less evident

1. Hashimoto thyroiditis: autoimmune disease of the thyroid gland that may be associated with other autoimmune disorders e.g. type 1 diabetes particularly in children with Down or Turner syndrome.

Clinical picture of congenital hypothyroidism

Neonatal period

No specific manifestations so screening is essential for diagnosis and prevention of mental retardation

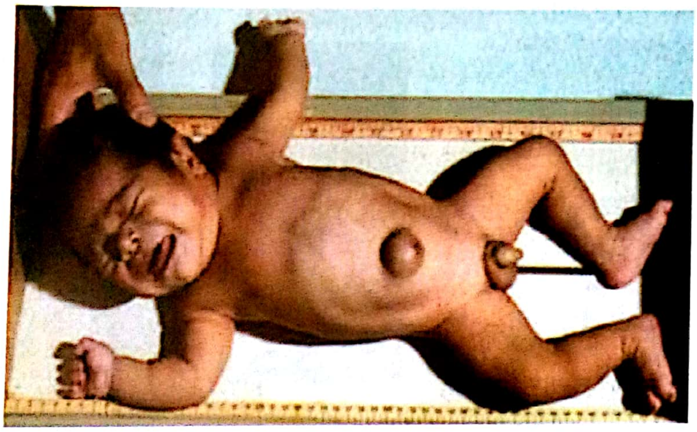
- **At birth**: no symptoms due to trans placental passage of maternal T4 (thyroxin).
- **Later on: early weeks of life**

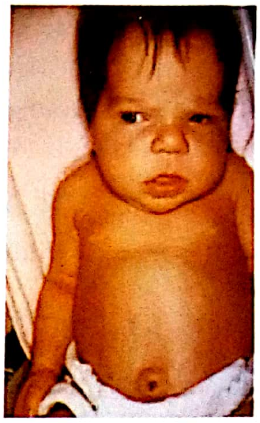
History

1. Prolonged gestation period may be noticed
2. Prolonged jaundice.
3. Poor feeding
4. Crying is little with much sleep (decreased activity)
5. Constipation

Examination

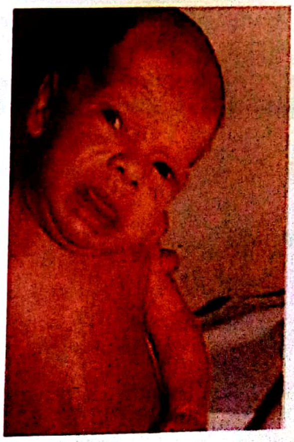
1. Fontanels: Widely opened anterior and posterior fontanels
2. Failure to thrive
3. Hypothermia (cold, mottled skin) and slow pulse
4. Hypotonia: Abdominal distention and umbilical hernia

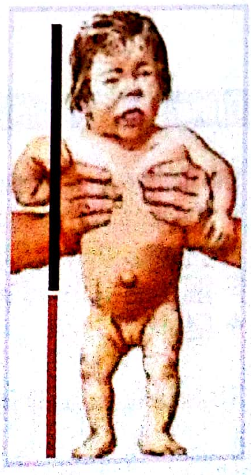


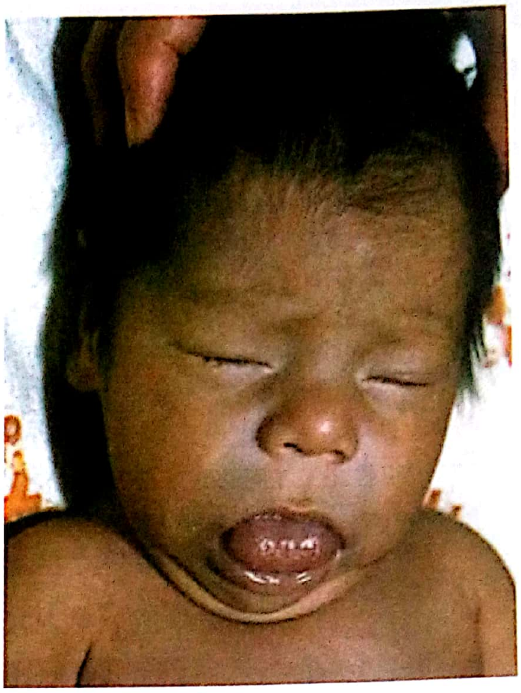


In older infants and children: late manifestations

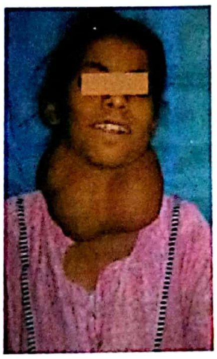
1. **Motor retardation**: delayed sitting, standing and walking.
2. **Mental retardation**: delayed mother recognition and speech development.
3. **Physical retardation** in neglected cases: 'Short stature with inappropriate upper segment/lower segment ratio, body retains infantile proportion 1.7/1 (the limbs are short because thyroxin is necessary for growth of long bones).

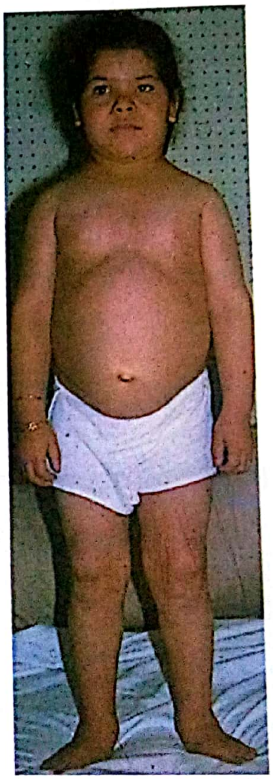




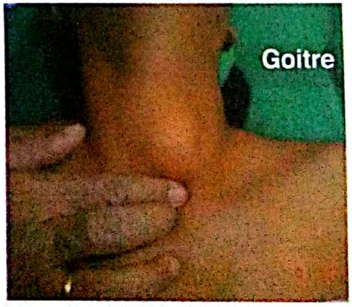


4. **Coarse features**
   - **Head**: widely opened anterior fontanels.
   - **Hair**
     - Coarse and brittle
     - Low anterior hairline.
   - **Forehead**: short and wrinkled.
   - **Eyelids** swollen (myxoedematous tissue)
   - **Depressed broad nasal bridge**
   - **Mouth**
     - Mouth is kept open with large protruded tongue.
     - Lips: pallor.
     - Delayed dentition.
   - **Neck**
     - Short and thick (myxoedematous tissue accumulation)
     - Goiter may be present
   - **Trunk**
     - Distended abdomen and umbilical hernia.
     - Skin: thick (myxoedematous tissue)
       Pallor (anemia)
       Yellow (hypercarotenemia).
     - Dry and scaly (vitamin A deficiency).
   - **Limbs**
     - Short limbs.
     - Hands: broad and short





Clinical picture of acquired hypothyroidism



The main 4 presentations are

1- **Physical**: Short stature
2- **Mental**: Deterioration in school work and learning difficulties
3- **Sexual**: Delayed puberty
4- **Others**: Goitre

Thyroid function is indicated in any of these 4 presentations

Investigations

Laboratory: Thyroid profile: T3, T4, T.S.H.

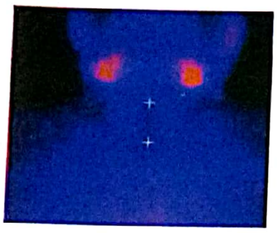
1. Low T4 (normal: 5-12 microgram/dL)
2. High TSH (normal: 0.5 – 4 micro unite/L). TSH is markedly elevated (above 50 micro unite/L). It is the most sensitive test for primary hypothyroidism.

Imaging

1. Thyroid scanning to detect developmental anomalies of the thyroid.
2. Plain X ray: delayed bone age.

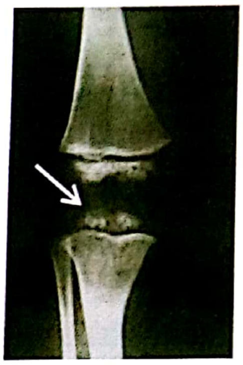
Neonatal thyroid screening

1. Timing: between 3rd and 7th day of life.
2. Technique: a blood drop is obtained by heel prick on filter paper and analyzed for TSH.
3. Interpretation: if TSH level > 20 mU/ L, an immediate blood sample is taken to confirm the result from the filter paper. If positive, treatment starts immediately.

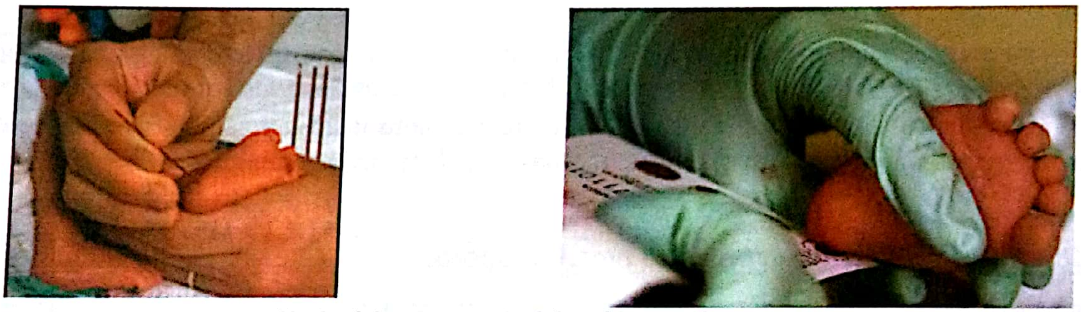


Thyroid agenesis

Normal scan



Epiphyseal dysgenesis
(Delayed bone age)



Heel prick test: neonatal thyroid screening

Treatment: Lifelong therapy with thyroxin

1. **Preparation:** Sodium-L thyroxin
2. **Dose**
   - Neonates: 10 microgram /kg/day.
   - Children: 100 microgram /m^2 /day.

   If treatment is delayed the calculated dose is reached gradually.
3. **Monitoring**
   - Clinical assessment
     - Physical: Height every 3 months and Bone age every year.
     - Mental development and I.Q.
     - Sexual: Pubertal development should be within normal.
   - Laboratory assessment: good response is associated with:-
     - T4 on high normal (10-12 microgram/dL)
     - T3 normal (70-220 ng/dL)
     - TSH on low normal (below 5 micro unit/L)

Diabetes mellitus

Definition

It is a metabolic disorder resulting from insulin deficiency due to islet ß-cell damage.

Types

- Type I : **Insulin dependent diabetes mellitus** (IDDM) in children
- Type II: Non-insulin dependent diabetes mellitus (NIDDM) in obese children : rare

Etiology and pathogenesis of type 1 diabetes

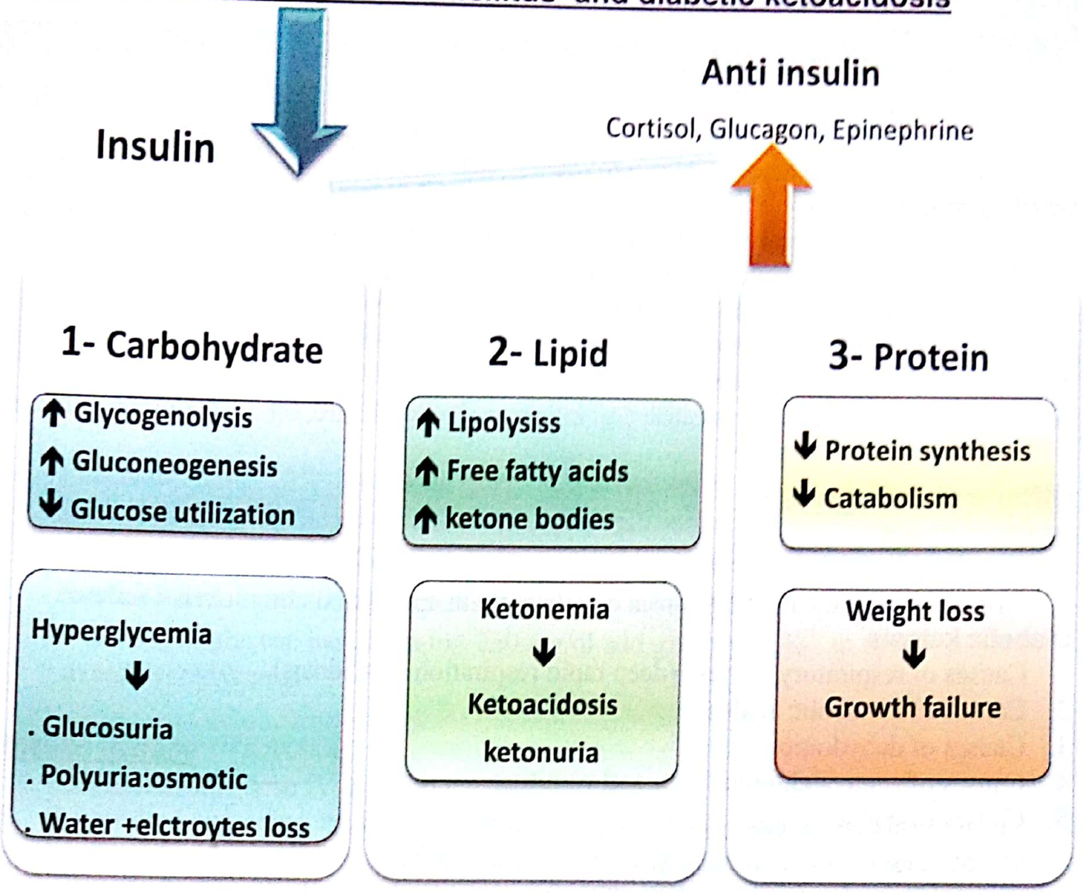
- Type 1 diabetes mellitus is an autoimmune disease triggered by environmental factors such as infections or toxins in genetically predisposed cases.
- Antibodies formed against B cells, cause B cell damage and decreasing insulin secretion to such low level where hyperglycemia and ketosis develop.
- 2 factors are important for the development of autoimmune process
  1. **Genetic susceptibility**
     There is an association between IDDM and susceptibility genes related to human leukocyte antigen (HLA)
  2. **Environmental predisposing factors: the most important are:**
     - **Viruses**: Mumps, chicken pox , congenital rubella and hepatitis, Coxsackie virus B4 and CMV
     - **Earlier exposure to cow's milk** (IDDM is less in breast fed babies).
     - **Chemical toxins** e.g. accidental ingestion of rodenticide.

- There is association between IDDM and other autoimmune disorders e.g. acquired hypothyroidism
- Monogenic diabetes: results from one or more mutations in a single, may lead to diabetes at very young age including neonates (neonatal diabetes monogenic); not common.

Comparison between type I and type II diabetes

Character	Type 1	Type II
Etiology	Polygenic (Multifactorial)	Polygenic
Incidence	Childhood: 90% or more of all young diabetic	Adults, less than 10% of young diabetics
Onset, course, duration . Onset . Course	 Acute and rapid Severe ketosis is common	 Insidious Ketosis is rare
Insulin . Secretion . Sensitivity . Dependence	 Absent or low Normal Permanent, total and severe	 Decreased Decreased Uncommon
Association . Autoimmune disorders . Obesity	 Present Absent	 Absent Severe

Pathophysiology of Diabetes mellitus and diabetic ketoacidosis



Insulin

Anti insulin

Cortisol, Glucagon, Epinephrine

1- Carbohydrate

- ↑ Glycogenolysis
- ↑ Gluconeogenesis
- ↓ Glucose utilization

Hyperglycemia ↓

- . Glucosuria
- . Polyuria:osmotic
- . Water +elctroytes loss

2- Lipid

- ↑ Lipolysiss
- ↑ Free fatty acids
- ↑ ketone bodies

Ketonemia ↓ Ketoacidosis ketonuria

3- Protein

- ↓ Protein synthesis
- ↓ Catabolism

Weight loss ↓ Growth failure

Clinical picture

It is uncommon before the age of 1 year, but the incidence rises during the early school years to reach a peak at 12-13 years.

1. Polyuria, polydipsia and recent weight loss: the main presentation. The duration of symptoms is usually less than 1 month in most cases
2. Secondary nocturnal enuresis due to polyuria (less common presentation)
3. Diabetic ketoacidosis represents the initial presentation in 10-20% of cases. Infection is the commonest precipitating factor (other precipitating factors are insulin under dosage and trauma either physical or psychological)

- Early manifestations
  - ➢ Vomiting and abdominal pain (excretion of ketone bodies in the stomach)
- Late manifestations (complications)
  - ➢ Dehydration and may be shock: due to vomiting and polyuria.
  - ➢ Deep rapid breathing due to metabolic acidosis + acetone odor of breath
  - ➢ Drowsiness due to cerebral depression and may be coma
  - ➢ Depression and arrhythmias of heart from acidosis and electrolyte disturbances

Abdominal pain
Vomiting

Dehydration

Ketone bodies depress both the heart and brain

Investigations

Ordinary cases

1. Fasting blood glucose: ≥126 mg/dl.
2. 2 hours postprandial: ≥200 mg/dl.
3. Random blood glucose: ≥200 mg/dl in the presence of diabetes symptoms.
4. Raised glycosylated hemoglobin: ≥ 6.5 %

Diabetic ketoacidosis

1. Blood glucose: hyperglycemia (blood sugar above 300 mg/dl)
2. Blood gas analysis: metabolic acidosis (low pH and bicarbonate)
3. Urine analysis: glucosuria and ketonuria
4. Urea, creatinine and electrolytes (especially potassium)
5. Cardiac monitor for T-wave changes of hypokalemia
6. Evidence of a precipitating cause e.g. infection (blood picture, blood and urine cultures)

Differential diagnosis

Ordinary cases

1. Nocturnal enuresis,
2. Causes of polyuria and polydepsia e.g. diabetes insipidus and chronic renal failure

Diabetic ketosis

1. Causes of respiratory distress (deep rapid respiration of acidosis)
2. Causes of metabolic acidosis
3. Causes of dehydration
4. Causes of acute abdominal pain and vomiting
5. Causes of coma

Complications

Acute complications

1. Diabetic ketosis (discus in short) and infections.
2. Hypoglycemia: blood glucose less than 45mg/dl (due to high dose of insulin or improper diet). Sweating, irritability, headache, convulsions and may be coma

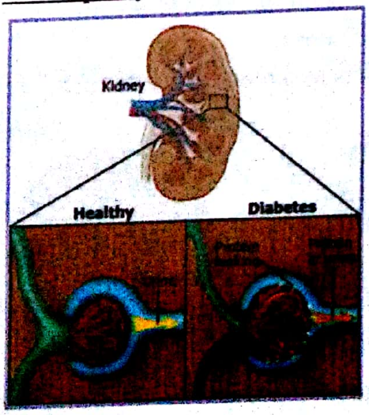
Long term complications: uncommon during childhood

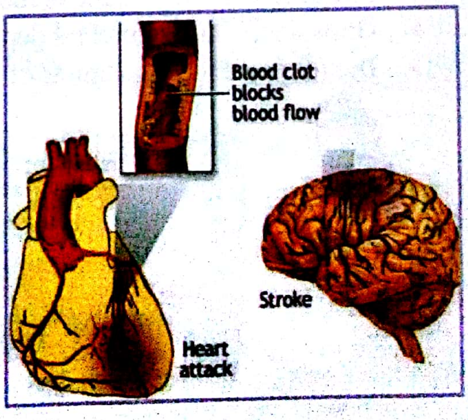
Levels of glycosylated hemoglobin above 7.5% are related to risk of later complications.

Glycosylated hemoglobin is formed from irreversible non enzymatic binding of glucose to the N terminal of hemoglobin.

It reflects the average plasma glucose over the previous few months

1. Nephropathy: microalbuminuria is an early sign, should be screened annually
2. Neuropathy (sensory and autonomic) and ischemic disease of the leg , and brain
3. Retinopathy. and Diabetic foot





Treatment

Hospitalization, better in ICU

1. **Fluid therapy in the first 24 -36 hours**
   - Deficit therapy : according to the degree of dehydration usually 50-100ml/kg
   - Maintenance: According to body weight or surface area
     - First 10 kg of body weight: 100 ml/kg/24 hours.
     - For each kg from 11-20 kg: 50 ml/kg/24 hours
     - For each kg above 20 kg : 20 ml/kg/24 hours
   - The total fluid (deficit plus maintenance) are given over (24 -36 hours). Correction must be gradual, rapid rehydration → cerebral edema

First hour	10% of the total fluid	Normal saline
Second hour	10% of the total fluid	normal saline
Next 10 hours	30 -40% of total fluids	0.45% saline ± k phosphate 30 mEq/L
Next 24 hours	30-40%of total fluids	0.45% saline± k phosphate 40 mEq/L

When blood glucose has fallen to≤ 250 mg/dl add glucose 5% to the IV fluids to avoid hypoglycemia

2. **Insulin therapy**
   - Continuous low dose IV infusion method.
   - 0.1unit/kg/hour, adjust the dose (rate of infusion) according to the blood glucose level.
   - Monitor the blood glucose regularly aiming for gradual reduction as rapid reduction →cerebral edema), when glucose become ≤ 250mg/dl, reduce the dose of insulin by 50% (0.05 unit/kg/hour).
   - When metabolic acidosis is controlled , stop intravenous insulin infusion and shift to subcutaneous insulin(0.2-0.4 units/kg/ 6 hours)

3. **Electrolyte therapy**
   - **Acidosis**: it is will self –correct with fluid and insulin therapy. Na bicarbonate is given in case of severe metabolic acidosis not responding to therapy (pH 7.1 or less). Alkali therapy may result in alkalosis that has its own hazards.
   - **Potassium therapy**: potassium should be added once urine is passed (initial plasma potassium may be high but it will fall following treatment with insulin and rehydration).

4. **Identification and treatment of triggering factors**: e.g. Antibiotics for possible bacterial infections

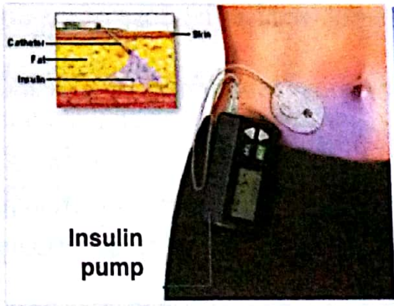
Treatment of ordinary cases (Long term treatment)

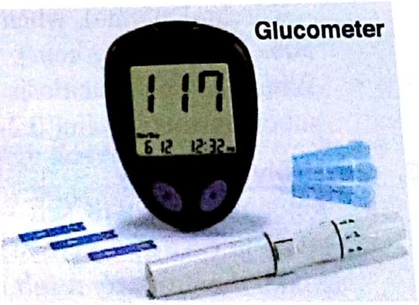
Diabetic control = Insulin + Diet + Exercise

Diabetic child should be hospitalized in diabetic unit to start treatment plane and to teach the child and parents the proper management

Insulin therapy

1. **Preparations**
   - Short acting (regular) insulin: Actrapid, Humulin-R
   - Intermediate acting insulin: Monotard, Insulatard, Humulin- N.
   - Combined short and intermediate acting insulin in a ratio of 30:70:not recommended
2. **Dose adjustment**
   - There is no fixed dose for insulin, the dose is individualized. The total daily dose ranging between 0.25-1 unit/kg/day given in 3 doses half an hour before the 3 meals.
   - The dose is adjusted according to repeated blood glucose estimation
   - The proper dose is that which maintain glucose level between 80 -120 mg% fasting and 120 -140 mg% postprandial.
3. **Mode of administration**
   - Subcutaneous injection(insulin pen or by syringe with short needle):
   - Continuous subcutaneous insulin infusion delivered by a micro-processor pump.
4. **Self-blood glucose monitoring**
   - Measuring blood glucose by himself or by his parents at home
   - It is done by strips that are read either visually or by glucometer.
   - It allows rapid detection of hypoglycemia or hyperglycemia and help in insulin adjustment
   - Glycosylated hemoglobin (HbA_{1C}) is particularly helpful as a guide of overall control over the previous 6 weeks and should be checked regularly





Diet

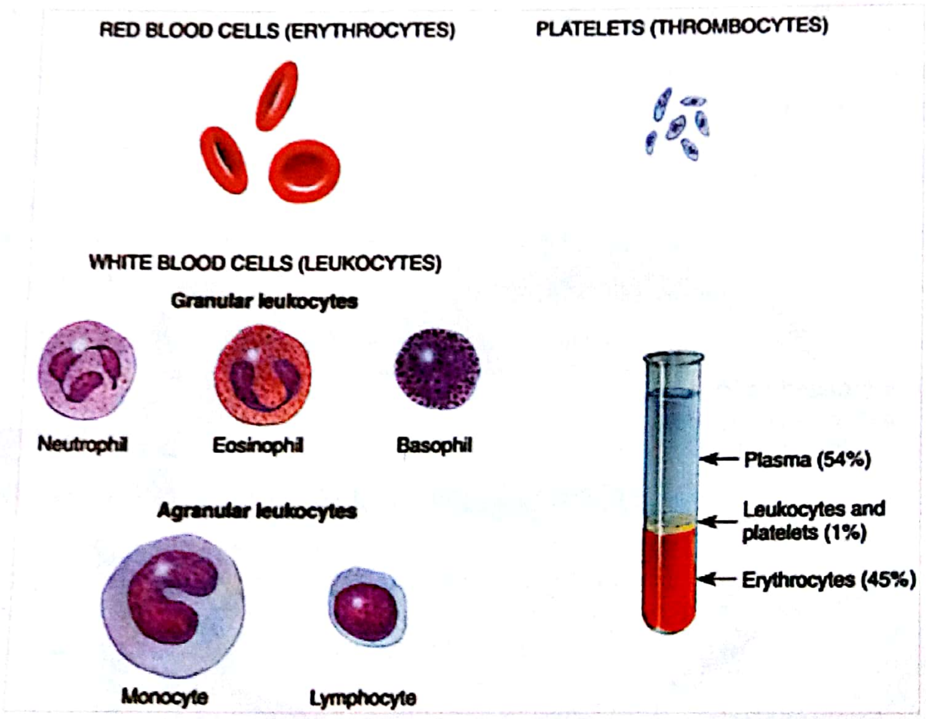
1. **Frequency**
   - 3 main meals and 3 snacks between meals and before going bed.
   - Snacks are required to avoid hypoglycemia
2. **Composition**
   - Carbohydrate (better complex carbohydrate) presents 55- 60 % of caloric requirement.
   - Fat: 25 % of total requirement: plant fat or oils, are preferred than animal fat
   - Protein: 15-20 % of total caloric requirement.
   - Fibers: food high in fibers provide sustained release of glucose, preferred than refined carbohydrate which causes rapid swing in glucose,
   - Minerals and vitamins should be encourage

Exercise

It should be encouraged as it increases the number of insulin receptors in the muscles and improves glucose utilization.

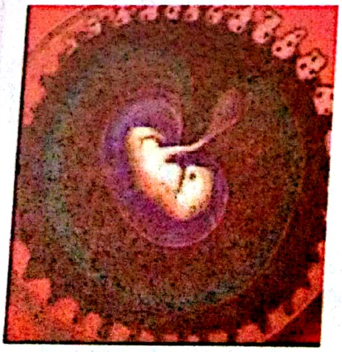
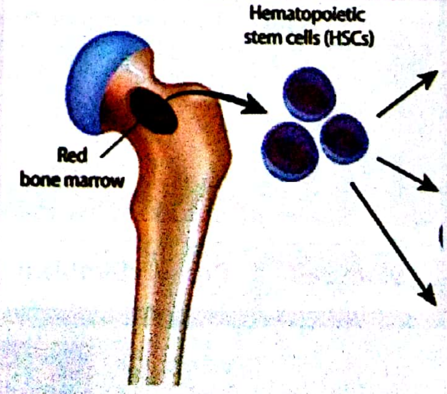
Hemopoiesis

- Blood consists of 3 elements, erythrocytes (red cells), leukocytes (white cells), and thrombocytes (platelets).
- All are derived from primitive bone marrow (stem cells) and present in plasma.



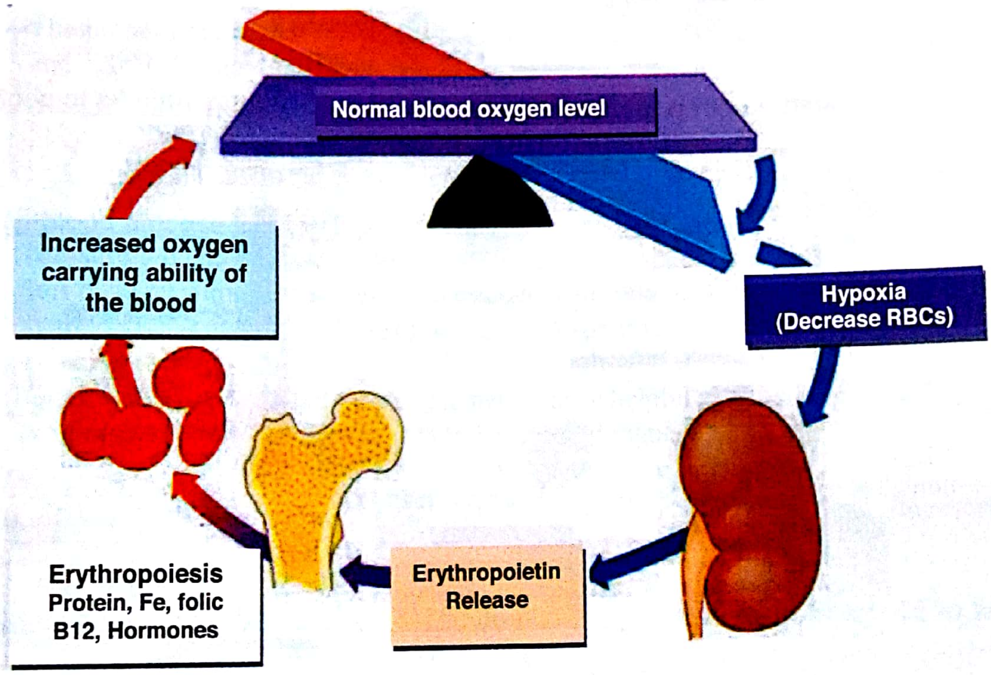
Sites of blood formation

- During the first 2 months : yolk sac
- Two to 7 months: liver
- Bone marrow starts at the 5th month intrauterine.
- After birth: bone marrow is the only site for production.
- Other sites that are *potentially* able to produce red cells if there is *increased demand* include spleen and liver (Extramedullary hemopoiesis).

The first 2 months **Yolk sac**	**2-7 months** **Liver**	**5th month** **Bone marrow starts**	**After birth** **bone marrow only**
			

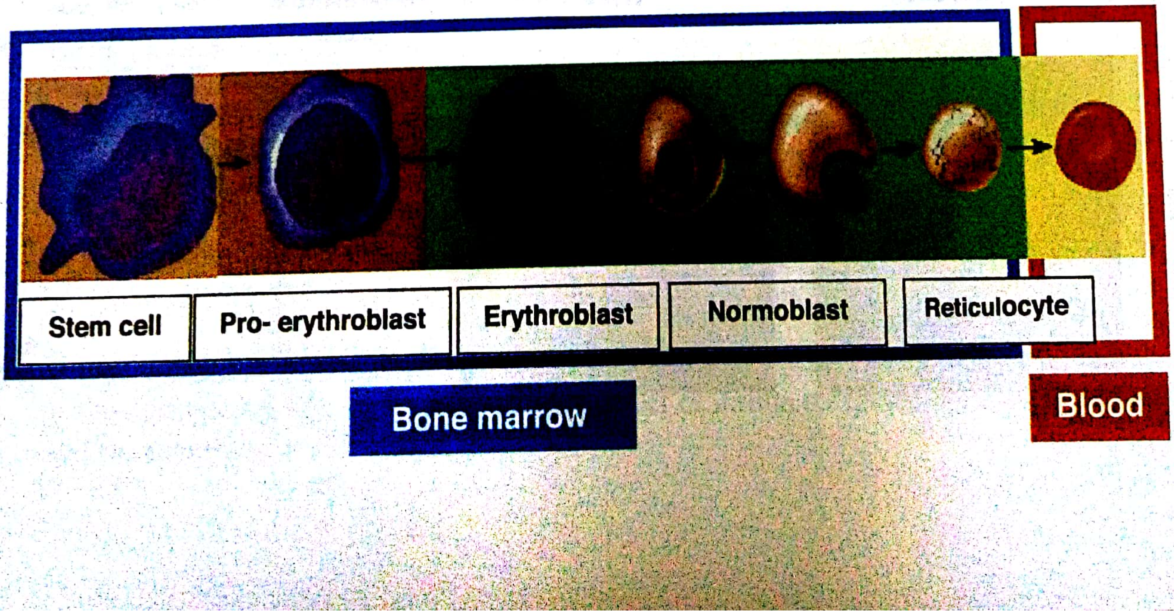
Factors controlling production of RBCs (factors controlling erythropoiesis)

1. **Hypoxia** stimulates erythropoietin production by the kidney, which is responsible for stem cell differentiation into mature erythrocyte.
2. **Nutritional requirements**
   - Minerals: Fe
   - Vitamins: B12, B6, Folic acid, vitamin C and vitamin E
   - Proteins
   - Trace elements: copper and cobalt.
3. **Hormones**: thyroid hormone and others(sex hormones, Adrenal, and pituitary hormones)
4. **Hematopoietic** growth factors.



Stages of red blood cells production

1. **In bone marrow**
   Stem cell →Proerythroblast→Erythroblast →Normoblast→reticulocyte
2. **In the peripheral blood**
   Erythrocytes +
   Reticulocytes: 0.5- 2% of total erythrocyte count (↑ in bone marrow stress).

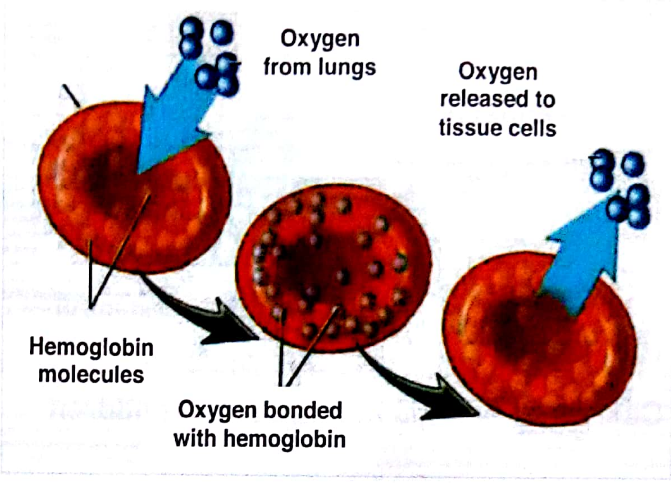


Structure of RBC

- Biconcave cell without nucleus or mitochondria containing hemoglobin.
- The main function is carrying oxygen.
- Old RBCs (120 ± 7days) are destroyed mainly in the spleen.

Red cell composition

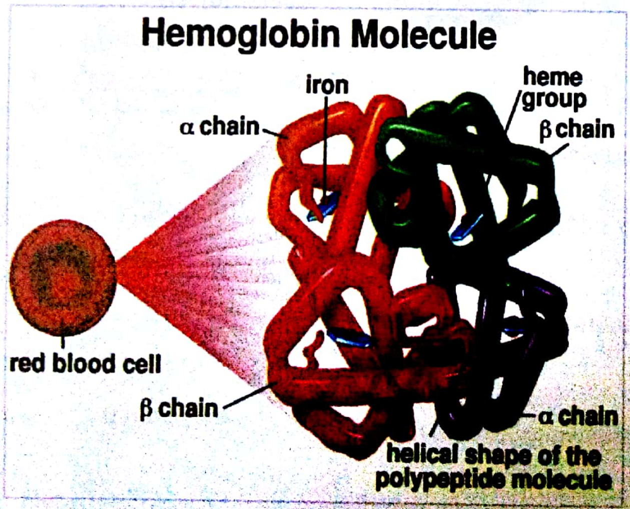
61%	Water
28%	Hemoglobin
7%	Lipids
3%	Carbohydrates
	Enzymes protein
1%	Metabolites

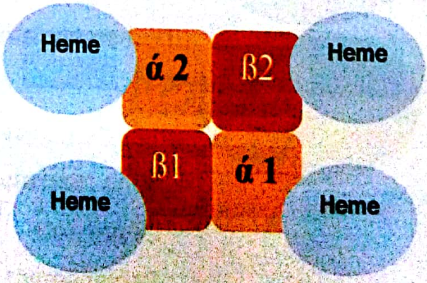

Oxygen from lungs
Oxygen released to tissue cells
Hemoglobin molecules
Oxygen bonded with hemoglobin

Hemoglobin

1. Heme group: iron protoporphyrin
2. Globin part: consists of 4 polypeptide chains (amino acids in a special sequence)
   2 alpha chains
   2 non alpha chains which differ according to the type of hemoglobin
   - Gamma chains in FETAL (HbF)
   - Beta chains in MAJOR ADULT (HbA)
   - Delta chains in MINOR ADULT (HbA2)

	Fetal	Major adult	Minor adult
At birth	70% ↓	About 30% ↑	Less than 1%
6- 12 months	Below 2%	More than 96%	2- 3 %



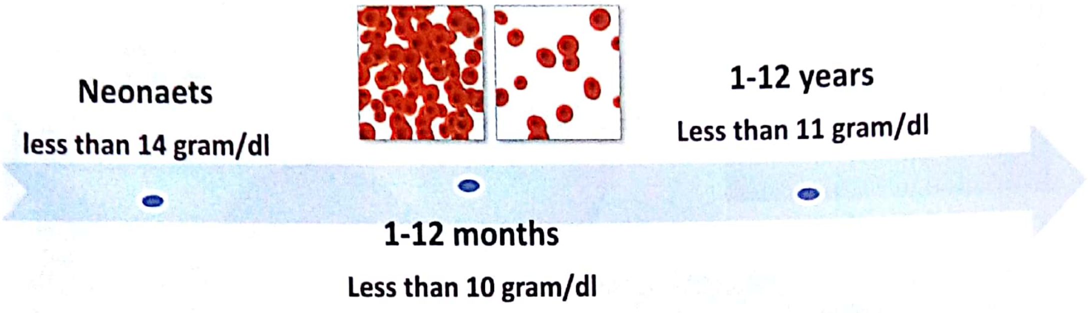


Major adult hemoglobin

Anemia

Definition

Reduction of hemoglobin concentration below the normal range for age.

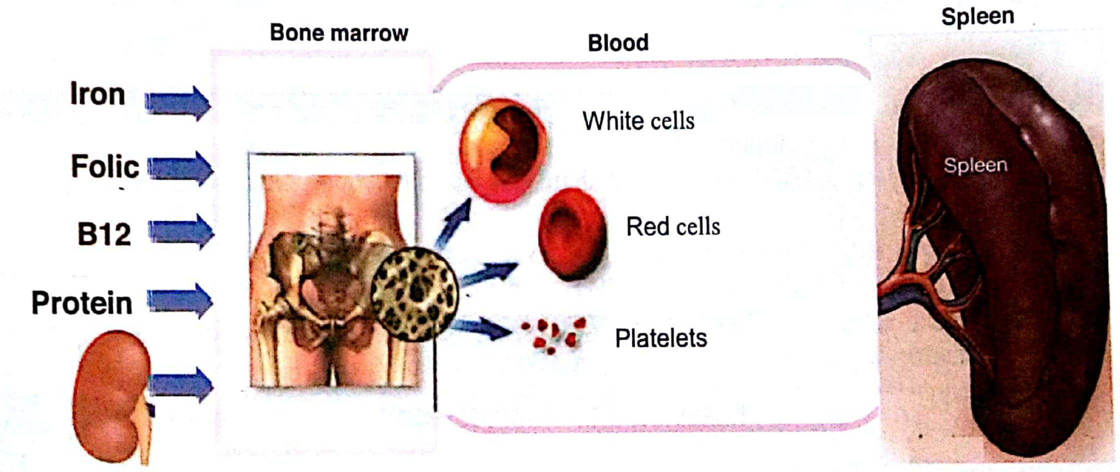


Neonaets
less than 14 gram/dl

1-12 months
Less than 10 gram/dl

1-12 years
Less than 11 gram/dl

Causes of anemia in infants and children



Decreased production

1.Dyshemopoietic

2. Bona marrow
. Depression
. Replacement

Increased loss

1. Hemolysis

2. Hemorrhage

3. Hypersplinism

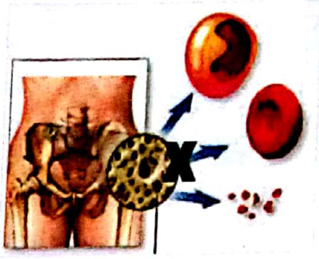
Decreased red cell production

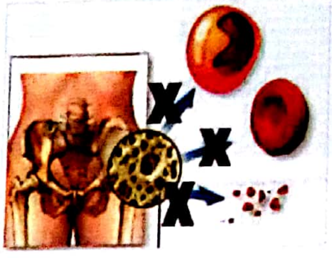
1. Dyshemopoietic anemia: deficient hemopoietic factors

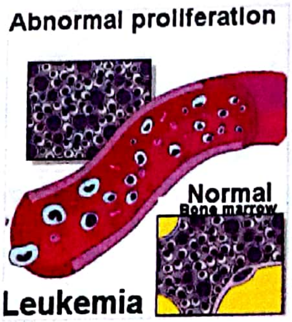
- Iron deficiency → Iron deficiency anemia (the most common cause of anemia).
- B12 and Folic acid deficiency→ Megaloblastic anemia.
- Protein deficiency.
- Chronic renal failure

2. Anemia of bone marrow origin

- **Bone marrow depression: decreased reticulocytes**
  - RBCs only : complete absence of red cell production : **red cell aplasia**
    - Hereditary: Diamond Blackfan anemia
    - Acquired: Parvovirus P19
  - All blood elements (pancytopenia) : aplastic anemia
    - Hereditary: Fanconia
    - Acquired: idiopathic, Infections (hepatitis B), toxins and irradiation
- **Bone marrow infiltration by abnormal cells**
  - Malignant cells e.g. leukemic cells.
  - Metabolic cells e.g. Gaucher cells



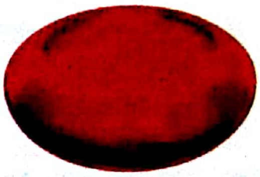




Increased red cell loss

1. Hemolytic anemia (may be acute or chronic): Increased reticulocytes

- **Hereditary: Intracorpscular**
  - Membrane defect e.g. hereditary spherocytosis and hereditary elliptocytosis
  - Hemoglobin defect e.g. Thalassemia and sickle cell anemia
  - Enzyme defect: Glucose 6 phosphate dehydrogenase and pyruvate kinase deficiency
- **Acquired: extra corpuscular**
  - Passively acquired antibodies
    Rh and ABO incompatibility or incompatible blood transfusion.
  - Actively acquired antibodies
    Autoimmune hemolytic anemia e.g. idiopathic or systemic lupus or malignancy



2. Hemorrhagic anemia

- **Acute blood loss**: big cephalhematoma , trauma , accidents and surgical causes
- **Chronic blood loss**:
  - Parasites: Ankylostoma, bilharziasis
  - GIT bleeding: Meckel's diverticulum or cow milk allergy

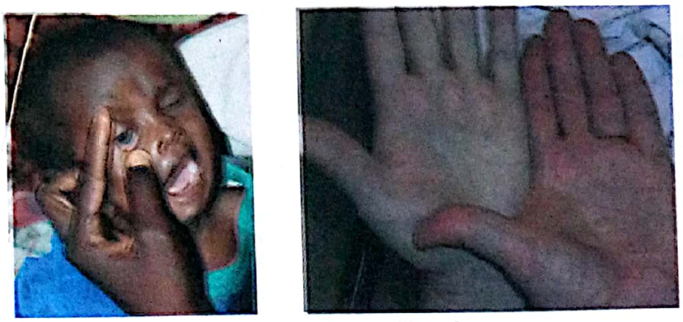
3. Hypersplenism : there is with pancytopenia with increased reticulocytes

Clinical picture of anemia

General clinical picture of anemia

- **Symptoms**
    1. General: Headache, easy fatigue, lack of concentration
    2. Cardiac: Exertional dyspnea and palpitation
- **Signs**
    1. General: Pallor (nail beds , lips and conjunctiva) : the most important finding
    2. Cardiac: Hyperdynamic circulation e.g. big pulse volume
        - Hemic murmur : systolic murmur
        - Heart failure in severe cases

Clinical picture specific for each type of anemia (discussed later on in details)



Pale lips, conjunctiva and hand creases

Hemic murmur

Hemolytic Anemias

Definition

Decreased red blood cell life span due to increased rate of destruction (intravascular or extra vascular hemolysis in liver or spleen). Normal red blood cell life span is: 120 days

Classification

Chronic hemolytic anemia

- **Hereditary: corpuscular**
    1. Membrane defect
        - Hereditary spherocytosis
        - Hereditary elliptocytosis
    2. Hemoglobin defect
        - Thalassemia
        - Sickle cell anemia
    3. Enzyme defect
        - Glucose 6 phosphate dehydrogenase deficiency (chronic type).
        - Pyruvate kinase deficiency
- **Acquired: non corpuscular :** chronic autoimmune hemolytic anemia

Acute hemolytic anemia: page

Thalassemia

Definition

Group of genetically determined chronic hemolytic anemia characterized by defective synthesis of one of the globin chains forming the major adult hemoglobin

Classification

1. Beta Thalassemia

Inability to form the Beta chain of hemoglobin, it occurs in three forms

Thalassemia major (Cooley anemia): severe illness.
Thalassemia intermedia: late onset and moderate severity.
Thalassemia minor: mild form and usually asymptomatic condition.

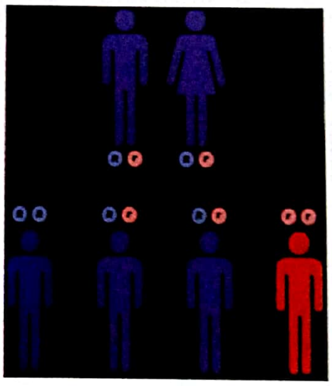
2. Alpha Thalassemia: rare

Deficient synthesis of alpha chain of hemoglobin

Thalassemia Major

Incidence

The commonest cause of chronic hemolytic anemia in Egypt.



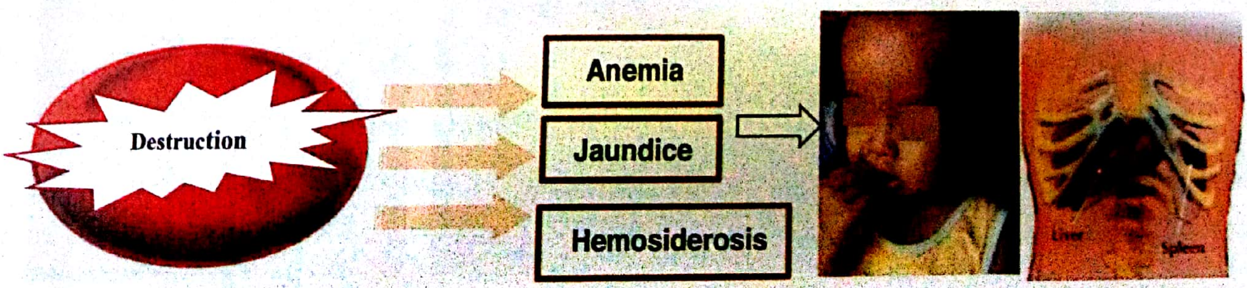
Etiology

- Hereditary, transmitted as autosomal recessive.
- The patient is homozygous for the abnormal gene.
- His parents are heterozygous for the gene (Thalassemia minor).

Heterozygous parents have a 1 in 4 risk of having an affected child

Pathophysiology

- Deficiency of beta chains, gamma chain synthesis continues beyond neonatal period, but inadequate.
- Hemolysis occurs as excess unbound alpha chain will precipitate in RBCs →destruction of RBCS in the bone marrow and in the spleen
- Red cell destruction → hemoglobin loss→ anemia, jaundice and hemosiderosis
- Trials for compensation:-
  - Bone marrow → reticulocytosis, hyperplasia and expansion of marrow spaces
  - Reticuloendothelial system→ hepatosplenomegaly and lymphadenopathy
- It presents *In the last part of the first year* when gamma chain synthesis stops and beta chain production does not occur. It is undetectable in the early months of life due to relatively large amount of Hb F.



Clinical picture

History

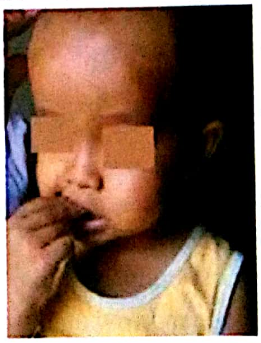
1. Onset: last part of the first year
2. Progressive pallor, mild jaundice , and abdominal distention (hepatosplenomegaly)
3. History of repeated blood transfusion.
4. Failure to thrive in early childhood is a common presentation.
5. History of crises: vasoocclusive crisis occurs only in sickle cell anemia, while other crises can occur in any type of chronic hemolytic anemia).
6. Family history may be positive (consanguinity and history of similar conditions).

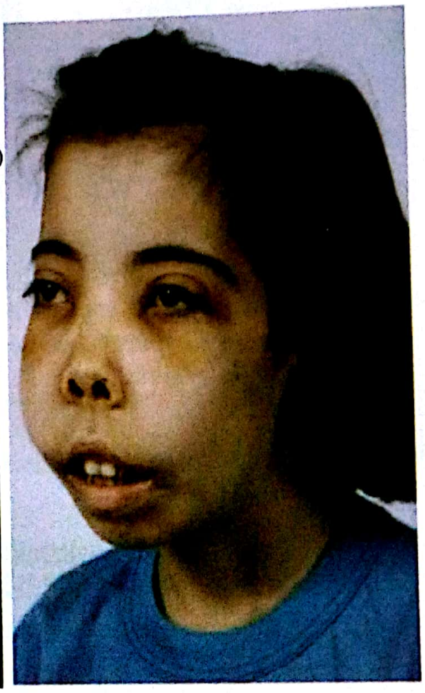
Examination

General examination

1. **Vital signs**
   - Manifestations of hyperdynamic circulation e.g. big pulse volume.
2. **Measurements**
   - Short stature due to chronic anemia and endocrinal disturbances.
   - Large head due to expansion of medullary spaces.
3. **Head**
   - Pallor
   - Mild jaundice
   - Skin color: greenish brown (pallor, jaundice, hemosiderosis)
   - Mongoloid features

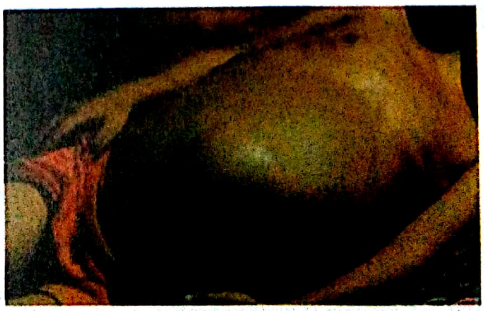
     Due to expansion of marrow spaces in the face
     - Depressed nasal bridge
     - Prominent maxilla
     - Protruding upper central incisors
4. **Neck:** lymphadenopathy





Systems examination

1. **Abdominal :**Huge splenomegaly and hepatomegaly as they are sites for:-
   - Destruction of RBCs.
   - Formation of new RBCs.
   - Deposition of iron overload.
2. **Heart**: hemic murmur.



Complications

Complications of repeated blood transfusion

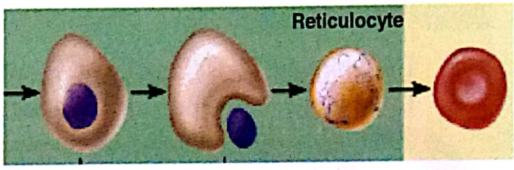
- **Iron deposition (hemosiderosis) the most important (in all patient) Each 500 ml blood delivers 200 mg iron in the body**
  1. Heart: cardiomyopathy, arrhythmia and heart failure that may be also due to anemia.
  2. Hepatic: liver cirrhosis and failure from hemosiderosis and blood borne infections
  3. Pancrease: diabetes mellitus (usually in the 2nd decade)
  4. Pituitary gland: delayed growth and puberty.
  5. Pigment gall stones due to increased bile pigment production.
  6. Pigmented skin
- **Antibody formation (10% of children)**: it makes finding compatible blood very difficult.
- **Blood born infections**: hepatitis C, B – HIV – malaria – CMV

Crises: hyper hemolytic, sequestration and aplastic crisis: P 181

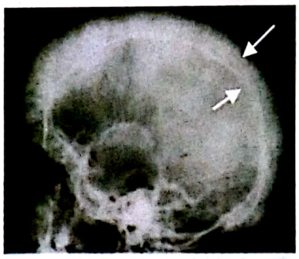
Investigations

1. To diagnose anemia as chronic hemolytic anemia

- Laboratory
  1. Blood picture
     - Chronic anemia (persistently low hemoglobin and low RBCs count)
     - Reticulocytes: reticulocytosis above 2% (normal 0.5 to 2% of total red cell count)



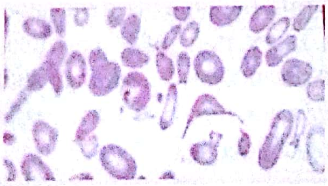
  2. Blood chemistry
     - Increased serum iron
     - Decreased iron binding capacity
     - Increased serum ferritin
     - Increased unconjugated bilirubin
- **Imaging** : late and not important finding for diagnosis



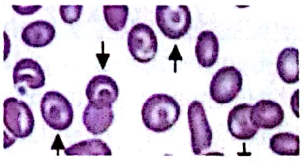
X ray skull: Hair on end appearance

3. To diagnose that the cause of chronic hemolysis is Thalassemia

- **Microcytic hypochromic anemia with anisocytosis, poikilocytosis and target cells.**



. **Anisocytosis**: variation in size
. **Poikilocytosis**: variation in shape



. **Target cells**: central area of density (hemoglobin) with surrounding pallor

- **Hb electrophoresis**
  . High hemoglobin F and reduced major adult hemoglobin.
  . Parents (thalassemia minor): increased minor adult hemoglobin.
- **Prenatal diagnosis: DNA analysis of a chorionic villus sample.**

Treatment

1. Correction of anemia
2. Iron chelating agents
3. Splenectomy
4. Bone marrow transplantation

1. Correction of anemia

- Repeated packed RBCs transfusion
    - 10-15 ml/ kg/ every 4-5 weeks to maintain Hb level at 10 gram% (hypertransfusion)
    - Advantages of hypertransfusion therapy:-
        - Allows normal activity.
        - Prevents progressive marrow expansion (decreasing the cosmetic complications).
        - Minimizes cardiac dilatation, liver and splenic enlargement.
- Folic acid tablet 5 mg daily to prevent megaloblastic changes in the bone marrow.

2. Removal and prevention of iron overload by iron chelating agents

- Deferoxamine (Desferal): 20- 40 mg/kg, subcutaneous by a pump over 10 hours, 5-6 nights/ week.
- Deferiprone: 75-100 mg/kg /day, oral divided into 3 doses.
- Defersirox: 10-20 mg /kg, oral once daily

Deferoxamine pump

3. Splenectomy

- **Indications**
    - Hypersplenism
    - Huge spleen causing pressure symptoms
- **Timing: not before 4 years to avoid sepsis**
- **Care of splenectomy**
    - Before splenectomy: vaccination against pneumococci, meningococcai and Haemophilus influenzae b
    - Long acting penicillin prophylaxis during childhood

4. Bone marrow transplantation: curative

HLA matched normal sibling is used as source of stem cells from the bone marrow or peripheral blood

5. Others

- Induction of fetal hemoglobin production by drugs: Hydroxyurea and L-carnitine.
- Gene therapy is under trial

Prognosis

- The condition is fatal without regular blood transfusion.
- Patient who comply regular transfusion and iron chelation have 90% chance of living into their forties. However compliance is difficult.
- Patient who cannot comply have a high mortality in early adulthood.

Thalassemia minor: β thalassemia trait

- Most cases are asymptomatic
- Blood picture: microcytic hypochromic anemia with no obvious signs of hemolysis.
- Hemoglobin electrophoresis: increased HbA2 (minor adult hemoglobin).In 50% mild elevation of Hb F (fetal).
- The condition is suspected when a patient with microcytic hypochromic anemia fails to respond to iron therapy.
- It can cause confusion with mild iron deficiency anemia and lead to unnecessary iron therapy.

Sickle Cell Anemia

Incidence

More common in black Africans.

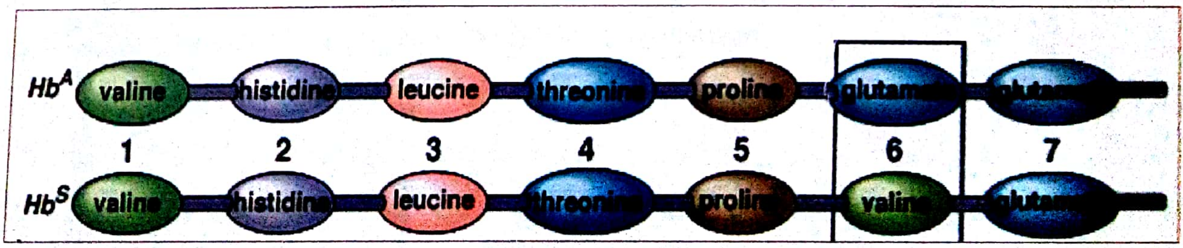
Etiology

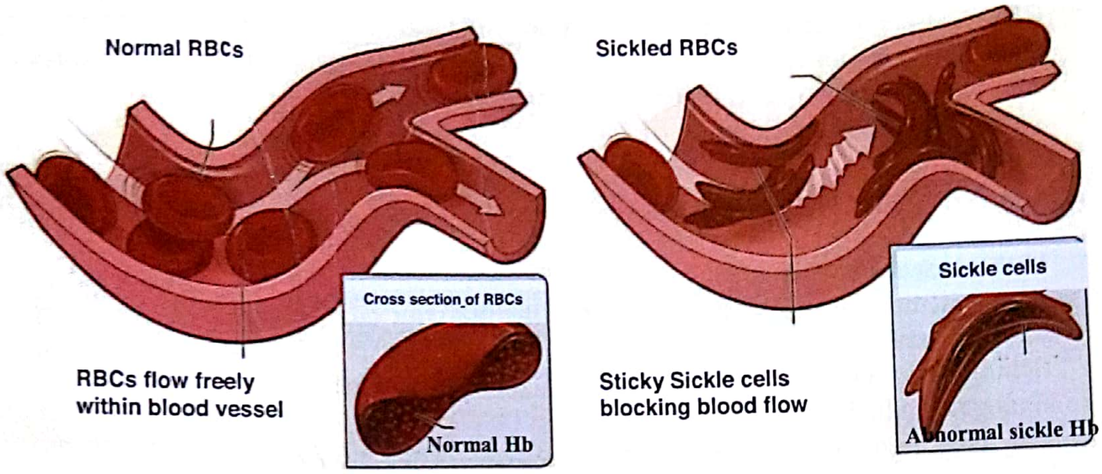
It is transmitted as autosomal recessive. 2 forms of the disease are present

- Homozygous form(two abnormal genes): **sickle cell anemia**
- Heterozygous form(one abnormal gene): **sickle cell trait**

Pathogenesis

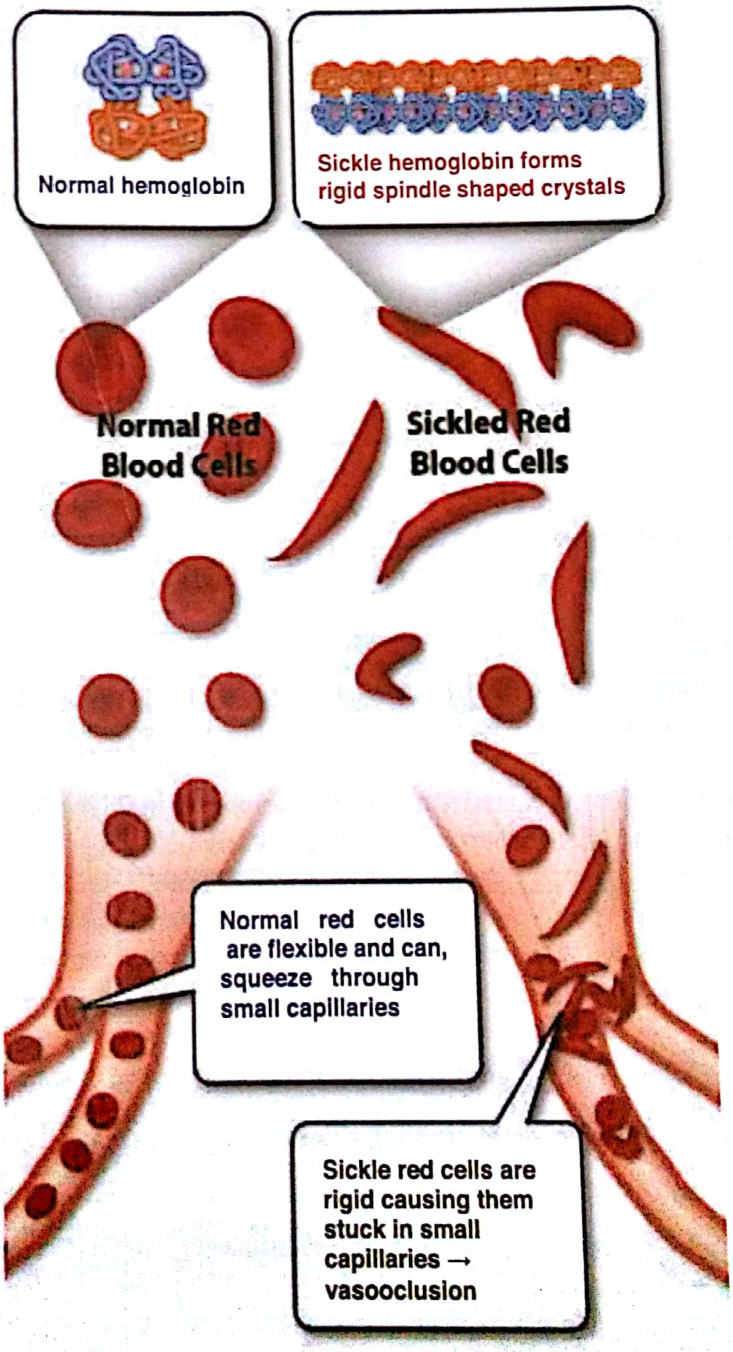
1. Single amino acid substitution in the beta chain (amino acid number 6 is valine instead of glutamic acid) →hemoglobin S (Sickle hemoglobin) is formed instead of HbA(major adult hemoglobin).
2. Hemoglobin S in the deoxygenated state forms insoluble spindle shaped crystals that distort the RBCs shape (sickle shape instead of biconcave)
   - Sickle cells are prematurely destroyed (being rigid)➔hemolysis
   - Sickle cells express a number of adhesion molecules which cause them to adhere abnormally to the vascular endothelium➔ obstruct blood flow in the microcirculation ➔vascular occlusion, thrombosis and infarctions.





RBCs flow freely within blood vessel

Sticky Sickle cells blocking blood flow



Sickle hemoglobin forms rigid spindle shaped crystals

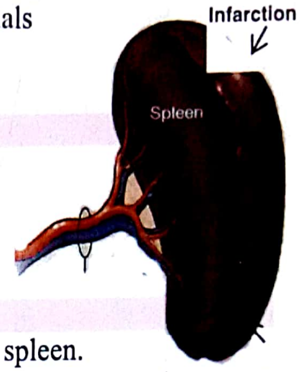
Normal red cells are flexible and can, squeeze through small capillaries

Sickle red cells are rigid causing them stuck in small capillaries → vasoocclusion

Clinical picture

Onset

- It presents *In the last part of the first year* when gamma chain synthesis stops and abnormal Hb S is produced in excessive amounts.
- It is undetectable in the early months of life due to relatively large amount of Hb F. However the presentations are variable between different individuals



Picture

General clinical picture of chronic hemolytic anemia

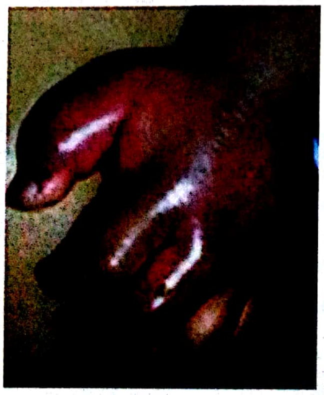
1. Chronic moderate anemia (pallor), jaundice and hepatomegaly
2. Spleen initially enlarges but repeated episodes of infarction cause its fibrosis by age of 5-6 years (autosplenectomy).

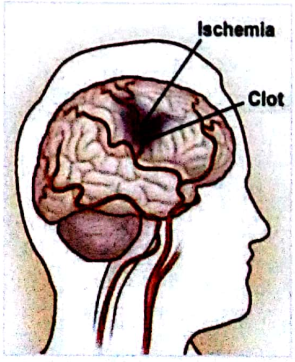
Increased susceptibility to Infections

1. It is due to functional hyposplinism caused micro infarction in the spleen.
2. Capsulated organisms: Pneumococci and Haemophilus influenzae are the most important (absence of opsonization)

Crises: one or more of different crises may occur

1. **Vasoocclusive crisis**
   - **Incidence**: the most frequent (specific for sickle cell anemia)
   - **Predisposing factors**: infection, dehydration, cold, excessive exercise and hypoxia
   - **Manifestations** are due to vascular thrombosis and infarctions in different sites:-
     - Bones (metacarpals and metatarsals): painful swellings of the hands and feet → hand foot syndrome.
     - Spleen: repeated episodes of infarctions cause its fibrosis→autosplenectomy
     - Strokes due to cerebral infarction
     - Abdomen: severe abdominal pain
     - Acute chest syndrome: acute chest pain and respiratory distress and fever
     - Priapism: persistent, usually painful, erection that lasts for more than four hours
   - **Prophylaxis**: avoid exposure to cold, dehydration and severe exercise
   - **Treatment**
     - Hydration
     - Analgesics
     - Oxygen
     - Antibiotics
     - Exchange transfusion indicated in acute chest syndrome, stroke and priapism





2. Sequestration crisis

- For unknown cause large amount of blood become acutely pooled in the liver and Spleen→ shock, marked enlargement of the liver and spleen and acute anemia.
- Treated by IV fluids, packed RBCs transfusion and splenectomy for recurrent cases.

Hemoglobinuria

3. Hyper hemolytic crisis

- Patient with chronic hemolytic anemia who have in addition G6PD deficiency.
- It leads to acute anemia, hemoglobinuria (dark urine) and marked reticulocytosis.
- Treated by packed RBCs transfusion.

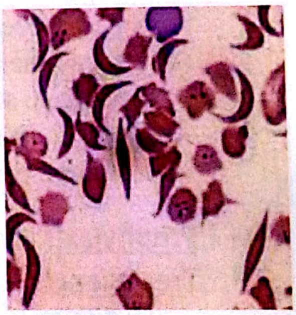
4. Aplastic crisis

- Transient episode of bone marrow failure that leads to acute anemia.
- There is failure of RBCs production and reticulocytopenia
- Treated by packed RBCs transfusion.

Complications

1. Complications due to repeated blood transfusions: discuss Page :
2. Crises: discuss
3. Increased susceptibility to infections: discuss

Investigations



1. To prove that anemia is chronic hemolytic (see Thalassemia)
2. To diagnose that the cause is due sickle cell anemia
    - Blood film: sickle shaped cell
    - Hb electrophoresis:
      Increased Hb S (90%-100%), absent Hb A (major adult)
    - Sickling test
    - Prenatal diagnosis: the same as in thalassemia

Treatment

1. General lines of treatment as Thalassemia (packed RBCs transfusion-iron chelating agents) but no place for splenectomy as there is (autosplenectomy)
2. Vaccination against capsulated organism, penicillin twice daily thought childhood
3. Hydroxyurea in severe cases (recurrent vasoocclusive crises) it increases Hb F production.
4. Bone marrow transplantation in severe cases who don't respond to Hydroxyurea .

Sickle cell trait (heterozygous form)

- Sickling does not occur under physiological conditions but in severe hypoxia.
- The patient is usually asymptomatic.
- HbS constitute 20 to 40% of total Hb mass and HB A (60-80%).

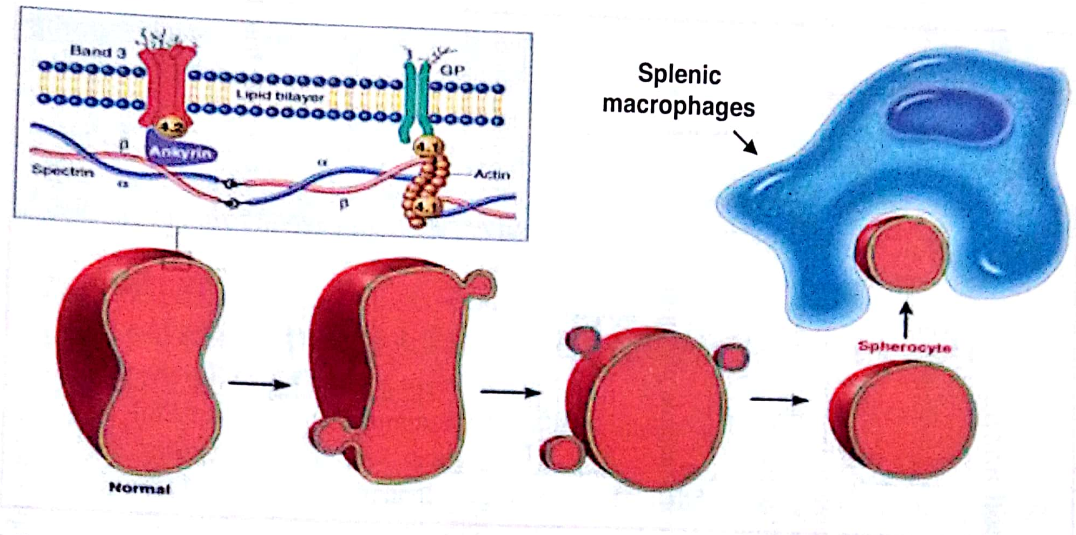
Hereditary Spherocytosis

Etiology

Hereditary, transmitted as an autosomal dominant, family history is usually positive

Pathogenesis (cell membrane defect)

- Defect in the red cell membrane skeletal protein (mainly spectrin, ankyrin) → this results in red cell losing part of its membrane→
- cells become sphere instead of the normal biconcave → less deformable, especially in the spleen → destruction in the microcirculation of the spleen



Clinical picture

Onset: may be as early as the first few days of life with anemia and neonatal jaundice

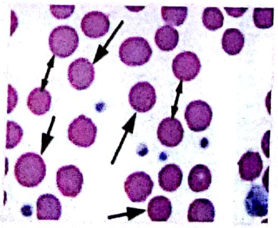
Picture

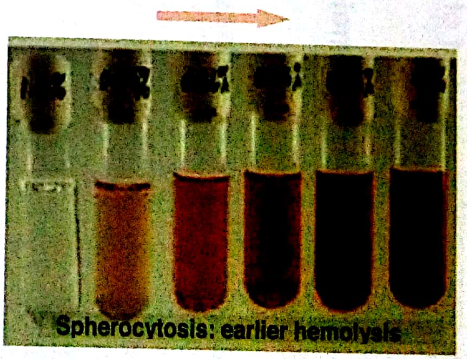
Picture of chronic hemolysis (pallor, jaundice, hepatosplenomegaly and mongoloid features), however, the clinical manifestations are highly variable:

1. Anemia is mild (9-11 g/dl). Some children have compensated hemolysis with normal hemoglobin.
2. Jaundice usually develops during childhood, it may be intermittent
3. Mild to moderate splenomegaly. May be the main presentation in the first year of life

Investigations

1. To prove that anemia is chronic hemolytic: see before
2. To diagnose spherocytosis:-
   - Blood film: spherocytes
   - Osmotic fragility test reveals increased fragility.





Treatment

1. Most children have mild anemia and the only treatment required is oral folic acid
2. Splenectomy improves the condition markedly but only indicated for poor growth or hypersplinism
3. Packed red cell transfusion if needed (less frequent).

Differential diagnosis of chronic hemolytic anemias

Thalassemia major	Sickle cell anemia	Spherocytosis
Etiology Autosomal recessive	Autosomal recessive	Autosomal dominant
Pathophysiology: the cause of hemolysis Abnormal hemoglobin: quantity Abnormal RBCS containing ά chain only due to $\downarrow\beta$ chain synthesis and inadequate gamma chain production	Abnormal hemoglobin: quality Abnormal rigid cell contain hemoglobin S (single amino acid substitution valine instead of glutamic) Vascular occlusion??ischemia	Abnormal cell membrane Defect in skeletal protein spectrin and ankyrin→ sphere
Clinical picture **Onset** Last part of the first year.	Last part of the first year: variable presentations	My be as early as the first few days of life.
Picture of chronic hemolytic anemia Severe anemia Failure to thrive Frequent blood transfusion(1/ 4 weeks) Huge splenomegaly and hepatomegaly All crises can except vasoocclusive	Moderate anemia Main problems : infection +crises Less frequent Hepatomegaly only (autosplenectomy) All crises can con occur	Mild anemia. Less frequent. Mild to moderate splenomegaly. All crises except vasoocclusive
Diagnostic investigations **Blood film** Microcytic hypochromic anemia with anisocytosis, poikilocytosis and target cells	Sickle shaped cell_	Spherocytes
Hemoglobin electrophoresis High hemoglobin F and ↓ Hb A	Increased Hb S , absent Hb A	**Osmotic fragility test:** Earlier hemolysis.
Treatment: general lines . Packed red cell. Iron chelating agents . Splenectomy if pressure symptoms or hypersplenism . Hydroxyurea . Bone marrow transplantation(standard treatment)	. Less frequent transfusion . Autosplenectomy . Hydroxyurea . Bone marrow transplantation in severe cases	Folic acid mainly Splenectomy if significant symptoms are present

Acute Hemolytic Anemias

Definition

It is anemia caused by acute (sudden) and rapid destruction of the RBCs in the peripheral blood. In many cases, it can be life threatening unless red cell transfusion was given rapidly

Glucose 6 phosphate dehydrogenase deficiency (G6PD)

Etiology

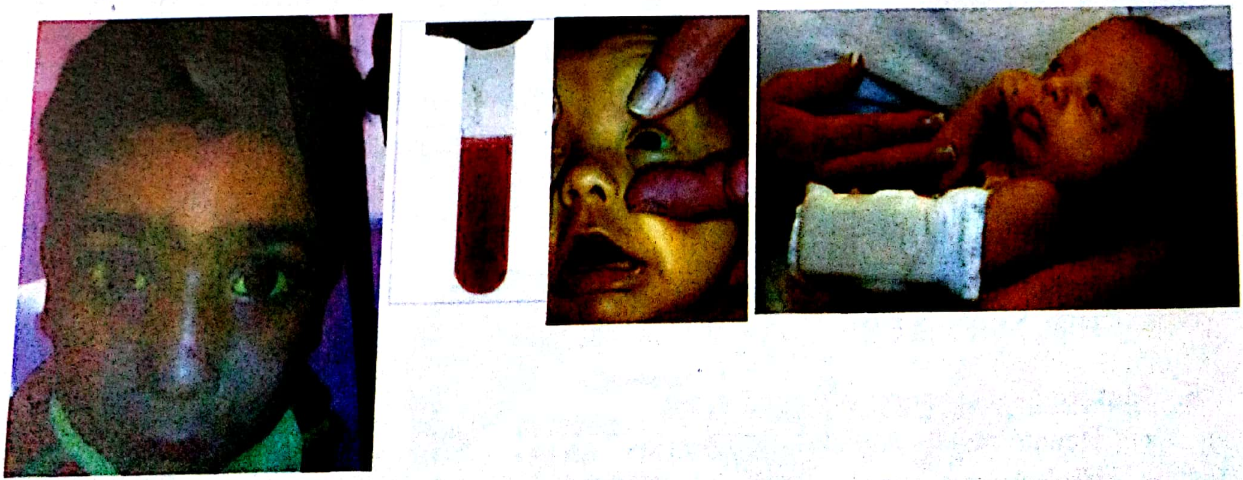
Hereditary, transmitted as X linked recessive. - more common in males.

Pathogenesis

- G6PD enzyme is involved in HMP shunt which is responsible for generation of NADPH and reduced Glutathione that protects RBCs from oxidation.
- With deficiency of G6PD, exposure to oxidant agents results in oxidation of hemoglobin to methemoglobin that precipitate inside red cells as Heinz bodies, these abnormal red cells are rapidly removed from the circulation leading to acute anemia

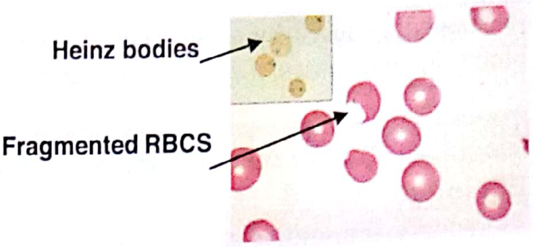
Clinical picture

1. **Picture of acute hemolysis 1- 2 days after ingestion of an oxidizing agent**
   - **Known oxidizing agents are**
     - Infection: the most common precipitating factor
     - Antipyretics: aspirin and novalgine
     - Antibiotics: chloramphenicol, sulfonamides, nalidixic acid and streptomycin and Antimalarial drugs and may be ascorbic acid
     - Chemicals: Naphthaline (mothballs)
     - Food: fava bean (Favism), Broad beans (the commonest agent in Egypt) and peas
   - **Clinical picture of acute hemolytic anemia**
     - Sudden pallor (acute hemolysis)
     - Sudden jaundice
     - Dark urine: pink to red (hemoglobinuria)
     - Tachypnea and tachycardia and may be impaired level of consciousness (acute hypoxia)
2. **In neonatal period**: may presents with neonatal jaundice in the first 3 days after birth, it may be severe that need exchange transfusion.



Investigations

1. **To prove that anemia is acute hemolytic anemia**
   - Normocytic normochromic with fragmented RBCs - reticulocytosis above 5%
   - Increased unconjugated bilirubin
   - Hemoglobinuria.



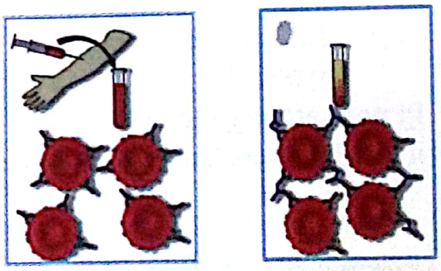
2. **To prove that the cause is G6PD deficiency**
   - Estimation of the activity of the enzyme 3 weeks after the attack
     Immediately after the attack there is high level of reticulocytes that have relatively higher enzymatic activity that may give false normal result.

Treatment

1. Avoid all oxidizing agents; parents should keep a list containing these agents.
2. During the attack: packed red cell transfusion 10ml/kg.

Other causes of acute hemolytic anemia

1. **Hemolytic uremic syndrome**
   - History of preceding gastroenteritis, acute renal failure and purpura.
   - Investigations: thrombocytopenia and impaired renal function test.
2. **Hyperhemolytic crisis: in patients with chronic hemolytic anemia** who have G6PD deficiency as well.
   - Repeated blood transfusion, mongoloid features, splenomegaly or hepatosplenomegaly
   - Hemoglobin electrophoresis and osmotic fragility test
3. **Hemolytic disease of newborn (Rh and ABO incompatibility) or incompatible blood transfusion**.
   - Jaundice on the first day of life (Rh, ABO). History of blood transfusion
   - Blood grouping, Coombs test



4. **Autoimmune hemolytic anemia**:
   - Huge splenomegaly, arthritis , rash
   - Marked reticulocytosis, +ve coombs test
   - Autoimmune hemolytic anemia may be due to
     - Idiopathic
     - Secondary
       - Systemic lupus erythematosus.
       - Infections: Cytomegalovirus, Epstein barr virus, mycoplasma pneumonia
       - Drugs: methyldopa, penicillin, cephalosporins.
       - Malignancy
5. **Infections (malaria) or sepsis**.
   - Fever, toxic appearance
   - High ESR and CRP – blood film in malaria
6. **Metabolic disorders: Wilson disease**
   - Hepatomegaly and chronic hepatitis
   - High urinary cupper and decreased serum ceruloplasmin

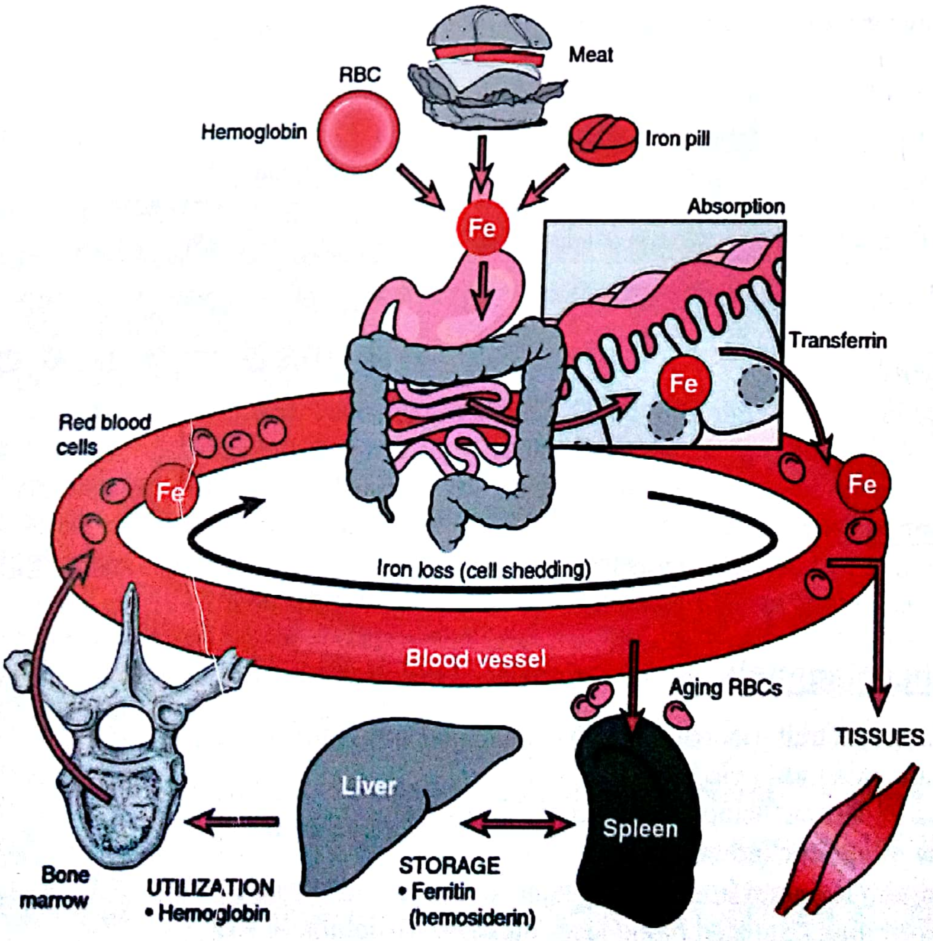
Iron Deficiency Anemia

Incidence

The most common cause of anemia in infancy: more common at 9-24 months

Iron metabolism

- **Daily requirement**
  - 10 mg/ day
  - Iron absorption is increased when eaten with food rich in vitamin C
- **Iron sources**
  - High in iron: meat, beef, liver, kidney oily fish
  - Average iron: Beans and green vegetables
  - Low in iron (food to avoid): Caw milk, Tea?
- **Absorption**
  - It is absorbed in ferrous form in the duodenum
  - Oxidized to the ferric and attached to apoferritin to form ferritin, when available apoferritin is saturated with iron, no further absorption occur
- **Distribution**
  - Iron is transferred in the plasma in the ferric state combined with transferrin.
  - Iron binding capacity is the amount of free transferrin ready to carry iron
- **Storage**
  - Iron is then delivered to the liver, spleen, bone marrow for either storage or hemoglobin synthesis (ferritin stores iron in the liver)



Etiology

1. **Inadequate iron stores at birth**
   - Severe iron deficiency anemia in the mother during pregnancy.
   - Fetal blood loss at or before delivery.
   - Premature and low birth weight infants or twins.
2. **Inadequate dietary intake**
   - Prolonged breast feeding after age of 6 months without supplementation with iron containing food: the most important cause.
   - Protein calorie malnutrition and consuming food poor in iron.
3. **Inadequate absorption**
   - Chronic diarrhea
   - Malabsorption syndromes
   - Prolonged use of cow milk
4. **Increased iron loss**
   - Hemorrhage: acute and chronic bleeding
   - Parasitic infections: ankylostomiasis and bilharziasis
   - During adolescence especially in girls (menstruation)

Clinical picture

It is uncommon before 4-6 months and become common at 9-24 months of age

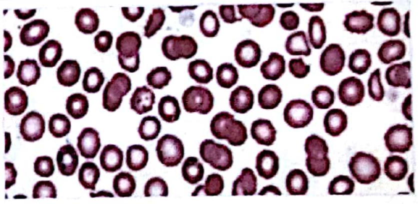
1. **Clinical picture of anemia IN GENERAL: Page 6**
2. **Specific manifestations of iron deficiency anemia**
   - Irritability and anorexia in advanced cases
   - Pica (pagophagia): the desire to ingest unusual things e.g. dirt or ice
   - Spleen is enlarged in 10-15% of cases
3. **History of the cause: delayed weaning - blood loss or malabsorption**

Investigations

1. **To diagnose anemia as iron deficiency anemia**
   - **Blood picture: microcytic hypochromic anemia (color index <1)**

     Reticulocytic count is normal

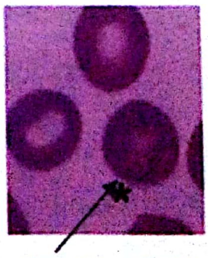
     Mild increases may occur 2-3 days of iron therapy



   - **Blood chemistry**
     - Decreased serum iron (N: 90-150 microgram %)
     - Increased serum iron binding capacity (N: 250-350 microgram %)
     - Decreased serum ferritin (reflects body iron stores: N: 30-150 nangam/ml).
2. **To diagnose the cause**
   - Stool: occult blood or parasites
   - Investigations for GIT bleeding (endoscopy) or malabsorption

Differential diagnosis: from other causes of microcytic hypochromic anemia

1. β Thalassemia trait (increased HbA2, increased serum iron).
2. ά Thalassemia trait (Hb Barts).
3. Anemia of chronic hemorrhage (occult blood in stool).
4. Anemia of chronic infections
   (Serum iron and total iron binding capacity are low or normal)
5. Lead poisoning (elevated blood lead- punctate basophilia of RBC)



Small particles of RNA Inside RBCs

Treatment

Prevention

1. Adequate supply of iron to the mother during pregnancy
2. Proper weaning: iron containing food (green vegetables or meat products) should be given to the infant from the 6th month.
3. Early diagnosis and treatment of the cause e.g. parasitic infestation – bleeding

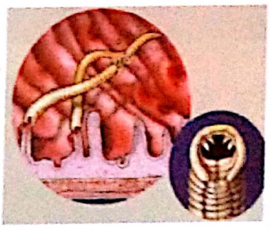
Specific treatment **iron therapy**

1. **Oral iron therapy**
   - Preparations: sodium iron edetate (sytron), ferrous sulfate or ferrous gluconate
   - Dose: 6 mg/kg/day 3 doses between meals
   - Course: 4-6 weeks after normalization of all blood values to replete the stores
   - Response: rise of Hb 1 gram/week
   - **Dietary advice regarding food rich in iron: enumerate some and what food to avoid**
2. **Intramuscular iron may be rarely needed in cases with malabsorption**
   - Preparation: iron dextran
   - Dose: 1 ml (50 mg) in infant – 2 ml (100mg) in young children
   - Course: 3 to 5 days
3. **Blood transfusion**
   - In impending heart failure or when there is serious infection.
   - Packed red cells:10 ml/kg slowly

Parasitic anemia

Etiology

1. Ankylostoma duodenale (more severe).
2. Bilharziasis.



Ankylostoma worms attached to the intestinal mucosa

Pathogenesis

1. Ankylostomiasis
   - Iron deficiency anemia
   - Intestinal protein loss in severe cases ➔ hypoalbuminemia.
2. Bilharziasis
   - Iron deficiency anemia
   - Secondary hypersplenism in some cases

Clinical picture

1. Clinical picture of iron deficiency anemia: discuss
2. Clinical picture of parasitism e.g. abdominal pain and weight loss.

Investigations

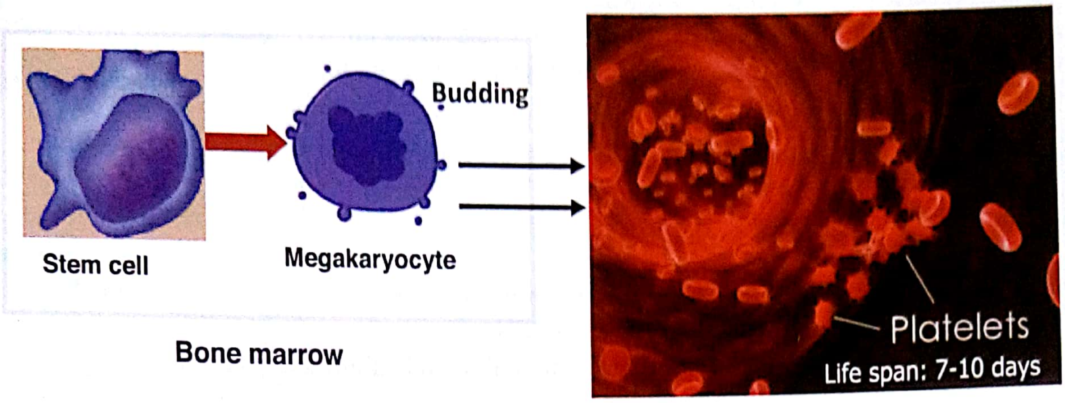
1. Of iron deficiency anemia: discuss
2. Of parasitism e.g. stool analysis- urine analysis

Treatment

1. Of iron deficiency anemia : discuss
2. Bilharziasi: Praziquentil 40-60 mg/kg single oral dose
   Ankylostoma : Flubendazol or albendazole 100 mg/dose twice daily for 3 days.
3. Blood transfusion may be indicated in severe cases

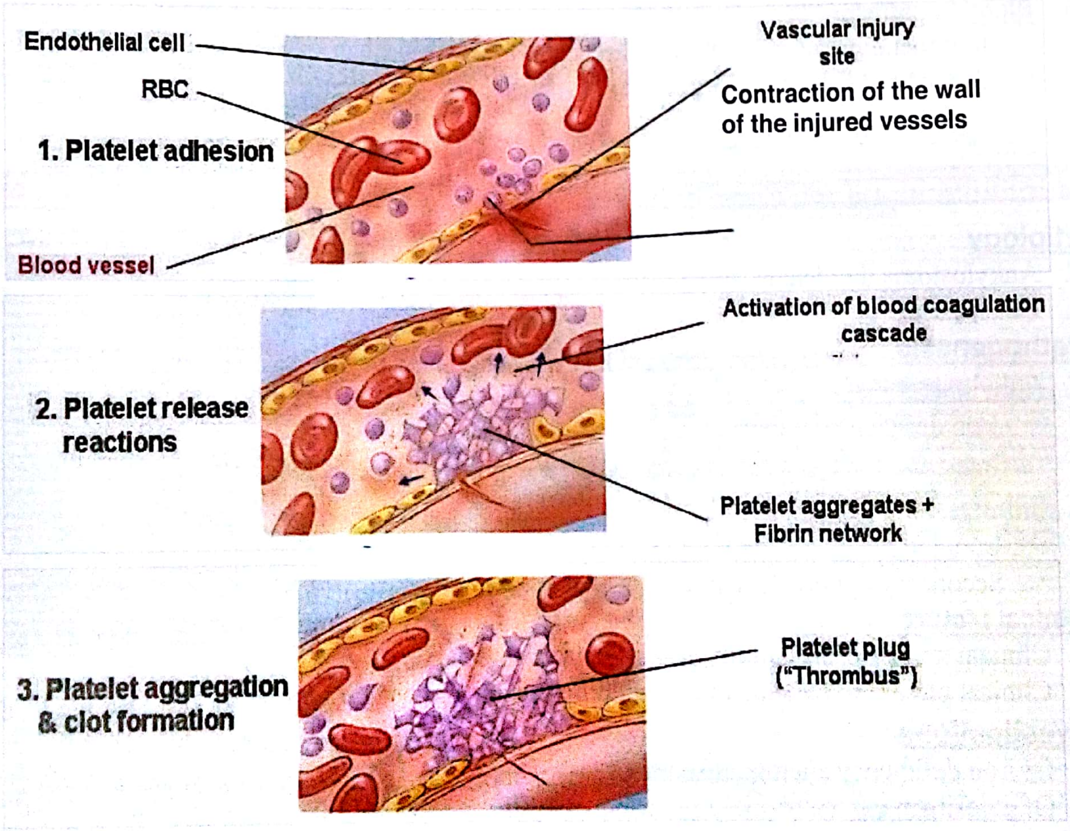
Anemia in protein energy malnutrion: kwashiorkor P: 52

Bleeding disorders



Hemostatic mechanism

1. **Contraction of the injured blood vessels**→ normal vessels' wall is essential
2. **Role of platelets** normal platelets' number and function are essential
   . Adhesion - Release reaction - Aggregation
3. **Clot formation** → normal coagulation factors are essential


Endothelial cell
RBC
1. Platelet adhesion
Blood vessel
Vascular injury site
Contraction of the wall of the injured vessels
2. Platelet release reactions
Activation of blood coagulation cascade
Platelet aggregates + Fibrin network
3. Platelet aggregation & clot formation
Platelet plug ("Thrombus")

Classification of bleeding disorders

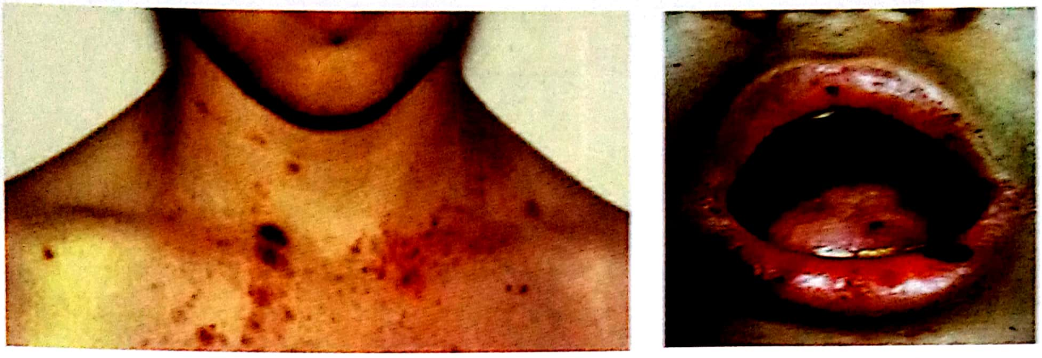
Purpura: defect in the wall of small vessels or in the platelet (number or function).

Coagulation disorders: Inherited: hemophilia or acquired e.g. DIC.

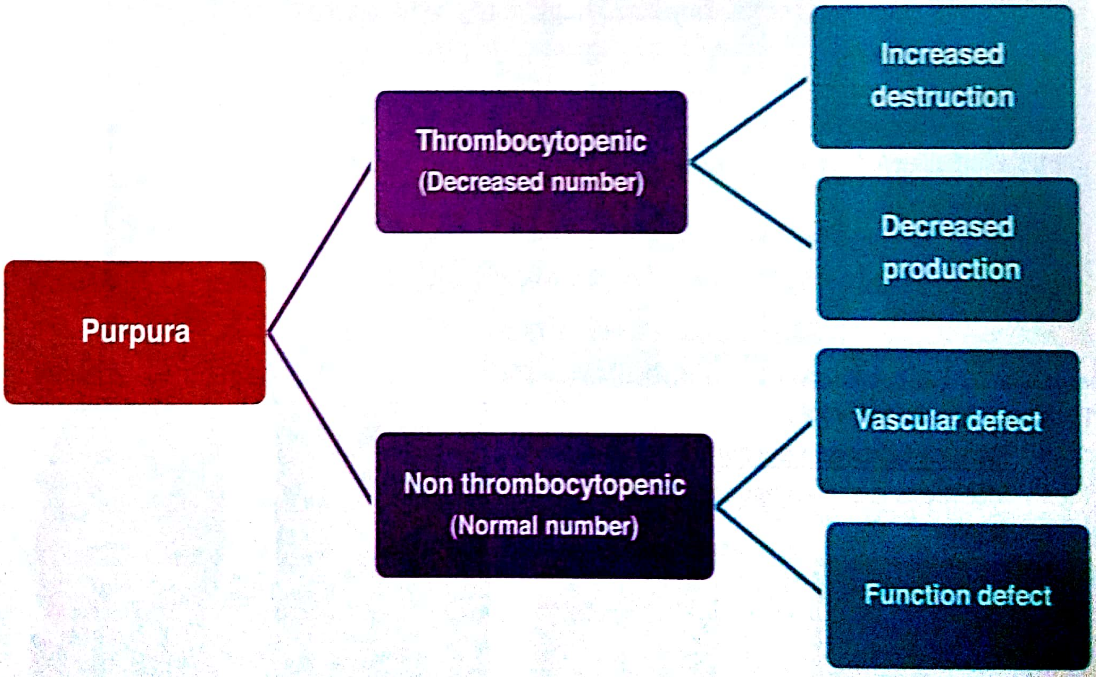
Purpura

Definition

Multiple spontaneous capillary hemorrhages (purplish petechiae and ecchymoses) in the skin or mucous membranes due to vascular or platelets defect (number or function).



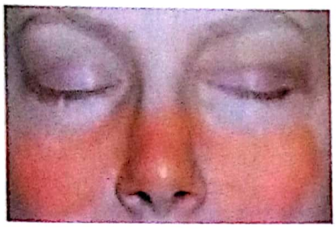
Classification According to the platelets number (150,000- 400,000/mm^3)

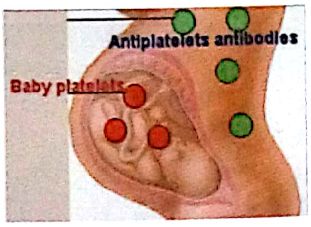


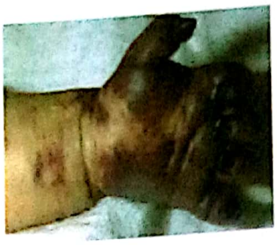
Thrombocytopenic purpura DECREASED NUMBER

1. Increased destruction (normal megakaryocytes)

- Immune
    - Immune thrombocytopenic purpura : ITP (the commonest cause)
    - Systemic lupus
    - Neonatal isoimmune or maternal ITP


SLE




DIC

- Non immune
    - Disseminated Intravascular Coagulopathy : DIC
    - Hemolytic uremic syndrome and thrombotic thrombocytopenic purpura
    - Hypersplenism
    - Drug induced
    - Infections

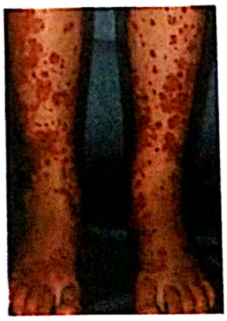
2. Decreased production (decreased megakaryocytes)

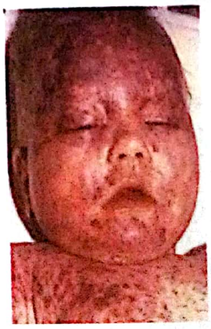
- Bone marrow depression
    - Congenital: Fanconi anemia, thrombocytopenia with absent radii
    - Acquired:
        - Aplastic anemia(idiopathic, drugs, toxins or irradiation)
        - Megakaryocytic aplasia (idiopathic, drugs)
- Bone marrow replacement
    - Congenital leukemia.
    - Acquired: leukemia, neuroblastoma, metabolic disorders
- Deficiency
    - Congenital: thrombopoietin deficiency.
    - Acquired: vitamin B12 and folic acid deficiency.

Non thrombocytopenic purpura NORMAL NUMBER

1. Vascular defect

- Henoch Schonlein purpura
- Infections e.g. meningococcemia
- Scurvy
- Drugs


Henoch Schonlein


Meningococcemia

2. Platelet function defect (thrombasthenia)

- Drugs e.g. aspirin
- Systemic disorders e.g. renal failure
- Hereditary thrombasthenia : aggregation and adhesive defects

Immune thrombocytopenic purpura

Definition

Acquired hemorrhagic state due to marked destruction of platelets by autoantibodies , in the presence of active bone marrow and absence of hepatosplenomegaly or underlying disease

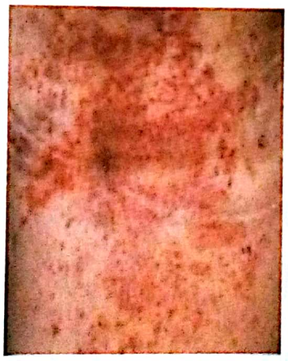
Pathogenesis: autoimmune destruction of the platelets

- Acute form (85-90%)
  - Usually proceeded by nonspecific viral illness or specific infections e.g. rubella or rubella immunization.
  - The virus itself or through alteration of platelet antigenicity leads to formation of antibodies that react with platelets.
- Chronic form (10-15%)
  - Persistence of clinical and laboratory findings for more than 12 months.
  - Related more to autoimmune disorders, it is due to disturbance of immune regulatory function. Genetic factors may have a role

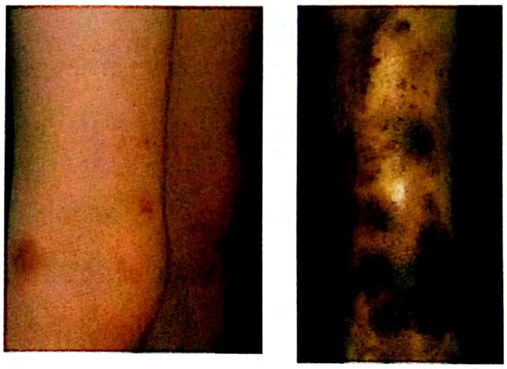
Clinical picture: acute onset, 1-2 weeks after a viral infection.

1. Purpura

- Nature: petechial hemorrhage (pin point) less commonly ecchymoses.
- Site: generalized over legs, neck and trunk.
- Surface: not raised and do not blanch on pressure.
- Color: purple in color when fresh then change within days to green then brown then fade

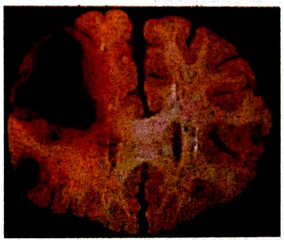

Petechiae
Less than 2mm

Purpura
2 mm to 1 cm


Ecchymoses
More than 1 cm

2. Bleeding

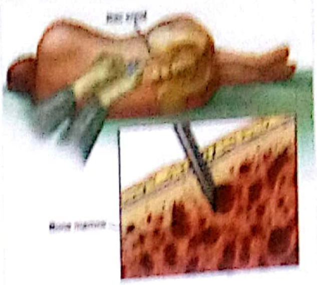
- Mucous membranes: Epistaxis, bleeding gum, hematemesis and hematuria.
- Internal organs: intracranial hemorrhage in 1% of cases.



2. Anemia: may be present due to blood loss.

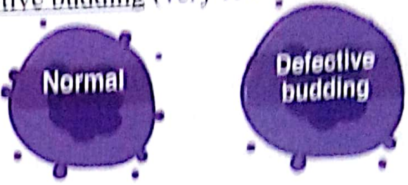
4. The liver and spleen are usually not enlarged.

Differential diagnosis: Page 198



Investigations

1. **Blood picture**
    - Thrombocytopenia usually less than 20,000/mm^3
    - Anemia if there is significant blood loss.
    - Normal white blood cell count with relative lymphocytosis
2. **Antiplatelet antibodies** in 60% of cases
3. **Bone marrow aspirate**
    - Normal or increased megakaryocytes with defective budding (very few platelets along their margins)
    - Normal granulocytic and erythroid series.



Treatment

Mild cases: cutaneous hemorrhage only (85% of cases)

No treatment, just observation and follow up. Avoid trauma and salicylates intake

Moderate: mucous membrane bleeding

1. **I.V. immunoglobulin or anti D**
    - Action : it binds to antibodies before attacking platelets
    - Dose: 0.8-1 gm/kg/day, given over 4-8 hours
    - Duration: 2 days
    - Excellent response: rapid raise of platelets.
2. **Steroids: prednisone**
    - Action: inhibit antibody synthesis and phagocytic activity.
    - Dose: 2 mg / kg/day
    - Duration: 2 weeks

Severe cases: severe muco-cutaneous hemorrhage or intracranial hemorrhage

1. **Steroids : methyl prednisone 20 mg /kg/day for 3 -5 days**
2. **I.V. immunoglobulin**
3. **Transfusion therapy**
    - Blood transfusion if significant hemorrhage occurs.
    - Platelet transfusion if serious bleeding is suspected (transient value)
4. **Plasmapharesis:** transient effect in refractory cases to all other forms of therapy.
5. **Emergency splenectomy** when there is no response to all measure

Chronic cases: more than 12 months

1. **Careful evaluation** for associated disorders e.g. systemic lupus.
2. **Trial of other measures** (steroids , immunoglobulin)
3. **Splenectomy** in severe chronic cases not responding to other measures
4. **Immunosuppressive** e.g. Azathioprine or cyclosporine.

Prognosis

1. The acute hemorrhage phase lasts only 1-2 weeks serious hemorrhage as intracranial hemorrhage is limited to this phase
2. Good prognosis: most cases (75 %) recover completely within 3 months.

Bone Marrow Failure Syndrome: Aplastic anemia (aplastic pancytopenia)

Definition

Aplasia of the precursors of the 3 blood element in the bone marrow leading to pancytopenia in the peripheral blood (anemia, purpura and infections). Splenomegaly and lymphadenopathy are absent (important differentiating point from leukemia).

Etiology

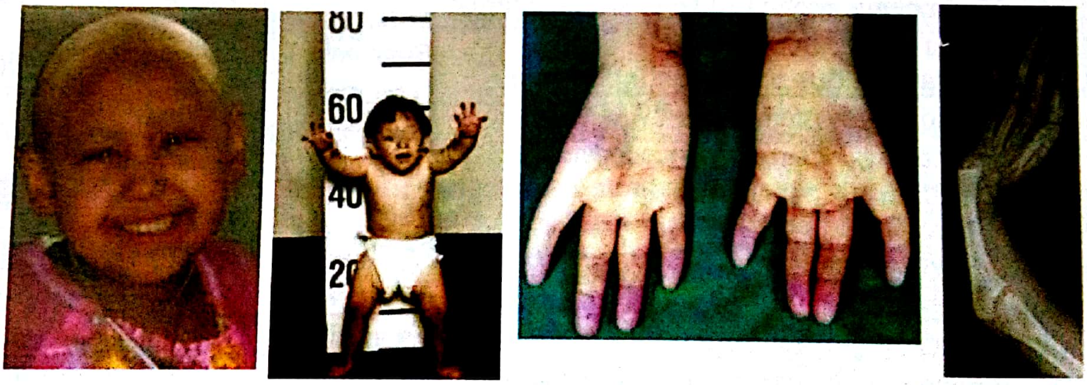
1. **Congenital or constitutional aplastic pancytopenia**: Fanconi anemia: autosomal recessive.
2. **Acquired**
   - Idiopathic.
   - Infections e.g. hepatitis B
   - Drugs e.g. chloramphenicol - sulphonamide- chemotherapy

} 50% of cases

Clinical picture

Constitutional aplastic pancytopenia: Fanconi anemia

1. **General manifestations**
   - Skeletal anomalies (present in 50% of cases): microcephaly, short stature, absent thumb and radius.
   - Microphthalmia and generalized hyperpigmentation may be present.
2. **Hematological manifestations**
   - Present usually above the age of 3 years with an average 6-8 years.
   - Thrombocytopenia starts first, followed by progressive severe anemia, and leucopenia.
   - Uncontrolled bleeding or infections are the main cause of death. Some cases may develop leukemia.

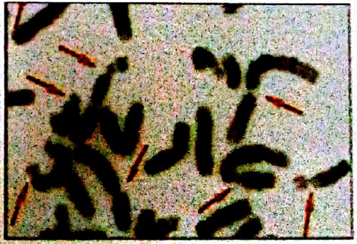


Acquired aplastic pancytopenia

1. The history is relatively short with purpura, anemia or repeated infections.
2. History of preceding infections or drug intake may be present

Investigations

1. Complete blood picture: pancytopenia(anemia is normocytic normochromic)
2. Bone marrow aspiration and biopsy: aplastic bone marrow (Hypocellular with depressed precursors of the 3 blood elements)
3. In Fanconi pancytopenia
   - Chromosomal study: increased chromosomal breakage.
   - Skeletal survey
   - Abdominal ultrasound



Treatment

1. Blood and platelets transfusion and control infections
2. Fanconi anemia
    - Prolong survival by androgen and corticosteroids
    - Bone marrow transplantation
3. Acquired aplastic anemia
    - Mild cases: Immune suppressive e.g. antithymocyte globulin or cyclosporine
    - Moderate and severe cases: bone marrow transplantation is the treatment of choice
    - If no compatible donor is available, immune suppressive drugs are given

Acute leukemia

The most common childhood malignancies.

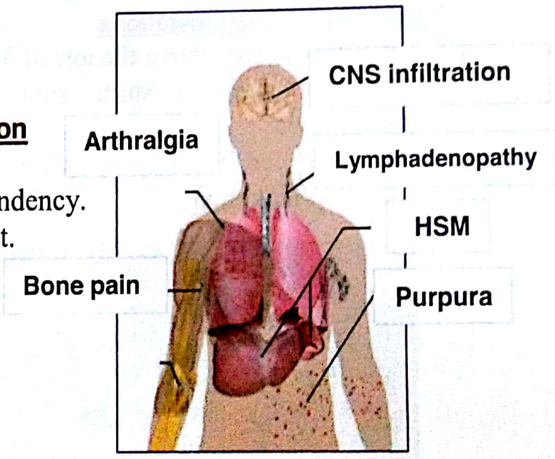
Malignant proliferation of white cell precursors (blast cells) infiltrating the bone marrow and may circulate in the blood forming leukemic deposits in many tissues.

Types

- Acute lymphoblastic leukemia (ALL)
  The commonest type: 75 % of childhood leukemia, it has better prognosis.
- Acute myeloid leukemia (AML): worse prognosis

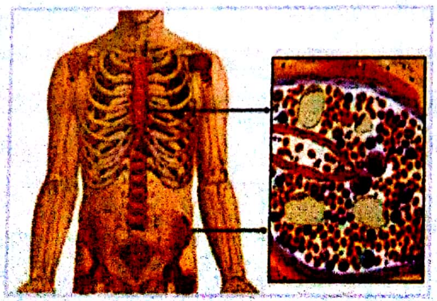
Clinical picture

1. **General manifestations**
    - Fever, malaise, anorexia and weight loss
2. **Manifestations due to bone marrow infiltration**
    - Anemia: pallor and lethargy.
    - Thrombocytopenia: purpura and bleeding tendency.
    - Neutropenia: prolonged fever and sore throat.
    - Arthralgia and bone pain.
3. **Manifestations due to organs infiltration**
    - Splenomegaly (common)
    - Hepatomegaly and lymphadenopathy.
    - C.N.S infiltration: headache, vomiting.



Investigations

1. **Blood picture**
    - Leukemic lymphoblast (ALL) is the most important finding.
    - Anemia and thrombocytopenia, leukocytic count may be increased or decreased.
2. **Bone marrow picture**
    - Infiltration with blast cells (ALL) or myeloid precursors (AML): diagnostic.
3. **Immunological and cryptogenic study** of the tumor cell (prognostic value).



Bone marrow infiltration

Bone marrow biopsy

Treatment

1. **Supportive measures: before and during treatment**
   - Anemia correction and platelets transfusion to correct bleeding tendency.
   - Antibiotics to treat any infection.
   - Allopurinol and hydration to protect renal function (↑ uric acid from cell lysis).
2. **Chemotherapy protocol**
   - **Induction of remission: (4 weeks):** vincristine, prednisone and asparaginase.
   - **Intrathecal treatment**: methotrexate, hydrocortisone and cytarabine.
   - **Systemic continuation therapy:** 2- 3 years by methotrexate and 6 mercaptopurine.
   - **Bone marrow transplantation** is an alternative to chemotherapy.

Henoch Schonlein Purpura

Definition

Systemic vasculitis (inflammation of blood vessels) characterized by deposition of immune complexes containing IgA antibodies. Platelets count is normal

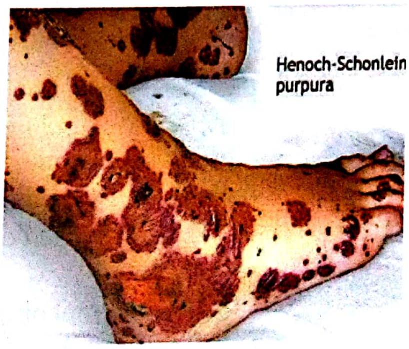
Etiology

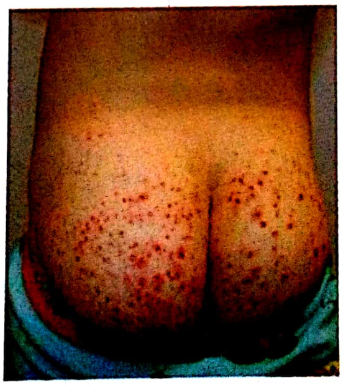
- Unknown
- It is usually preceded by an upper respiratory tract infection (peaks during the winter months)

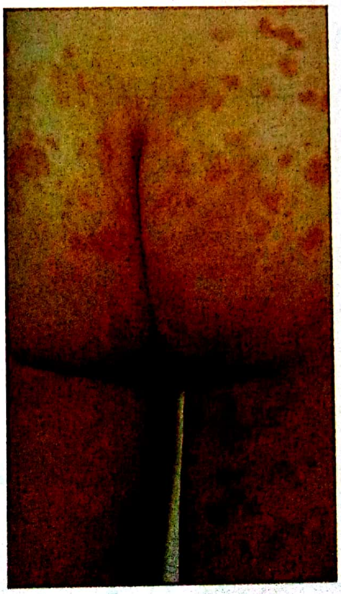
Clinical picture RAAR

It usually occurs between the ages of 3 and 10 years with higher incidence in boys

1. Purpuric palpable **Rash** : in all cases
   Over the back of the lower limbs and buttocks.it may extend to the trunk and limbs
2. Abdominal pain and GIT bleeding in 50% of cases.
3. Transient Arthritis: knee and ankle joints: in 2/3 of cases.
4. Renal: Nephritis in 1/3 of cases.







Investigations

Laboratory

1. Complete blood picture: normal platelet count
2. ESR, CRP : elevated (inflammation)
3. Urine analysis (screen for hematuria)
4. Stool analysis (screen for blood in stool)

5. Blood Urea, creatinine and C3: screen for nephritis
6. Ig A level (maybe elevated)

Imaging

1. X ray and abdominal ultrasound if any doubt regarding gut perforation or intussusception

Treatment

1. Non-steroidal anti-inflammatory drugs.
2. Steroids in cases with GIT bleeding or nephritis

Prognosis: Recovery within several days or few weeks.

Differential diagnosis of thrombocytopenic purpura

	ITP	Aplastic	Leukemia
History	- History of fever 2 weeks before the onset of purpura	- May be history of exposure to bone marrow depressant drugs or viral infection- the cause may be idiopathic - Fever(infections) - Repeated blood transfusion	- Prolonged fever - Arthralgia or arthritis - Recent significant weight loss
Examination	- Good General condition - No anemia except if there is significant bleeding - No organomegaly	- Bad general conditions - Marked pallor - No organomegaly	- Bad general condition - Pallor - HSM - Lymphadenopathy - Tender bone
Investigations Blood picture	- Thrombocytopenia	- Pancytopenia	-Thrombocytopenia, anemia, WBC may be normal , increased or decreased - leukemic lymphoblast
	- Antiplatelet antibodies: positive		
Bone marrow	- Defective budding	- Bone marrow aplasia	- Infiltration by leukemic lymphoblast

Coagulation disorders

Coagulation scheme

Phase 1: Formation of thromboplastin

Assessed by partial thromoplastin time (N: 25- 40 seconds) and clotting factors (8,9,11,12) assay

Phase 2: Formation of thrombin

Thromboplastin complex

Prothrombin(factor 2)➔ ➔➔➔thrombin

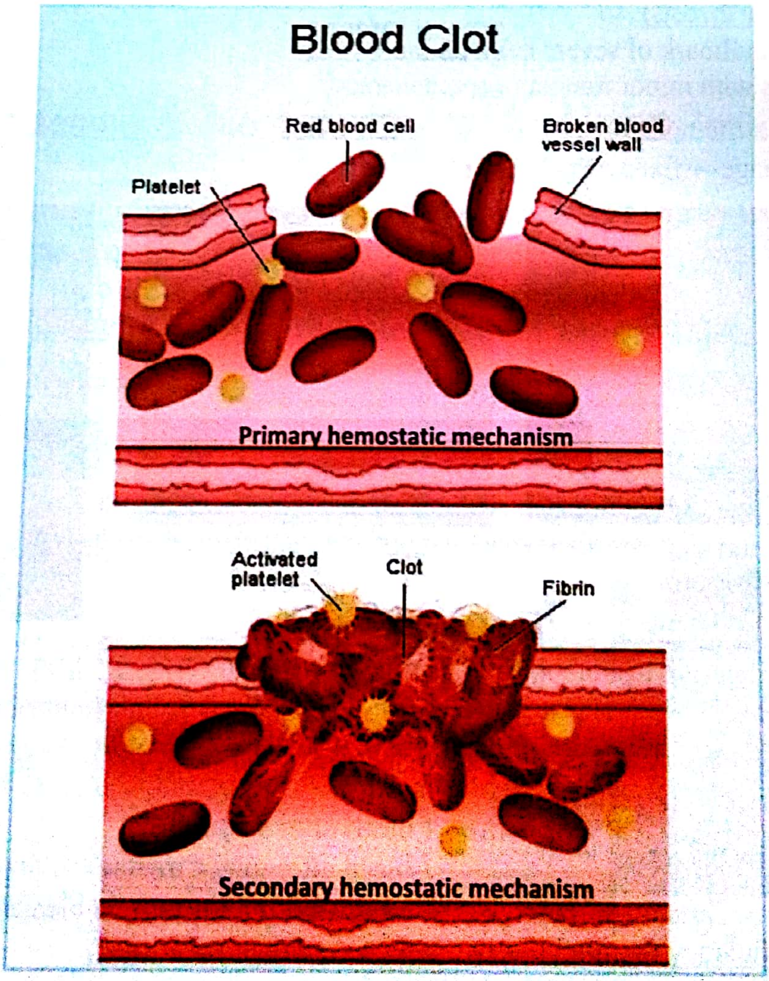
Assessed by prothrombin time(N: 11.5-14 seconds) and clotting factors(2,5,7,10) assay

Phase 3: Formation of fibirin

Thrombin

Fibrinogen➔ ➔➔➔ fibrin

Assessed by thrombin time(N15-20 seconds) and fibrinogn level



Hemophilia

Definition

Inherited coagulation disorder due to deficiency of factor

VIII	**Hemophilia A (classic hemophilia): X linked recessive**
IX	**Hemophilia B (Christmas disease): X linked recessive**
X1	**Hemophilia C: autosomal recessive**

Incidence

1. Hemophilia A: 1/4000 males: 80% of all hemophilia
2. Hemophilia B: 1/ 30000 : 15% of all hemophilia
3. Hemophilia C: rare

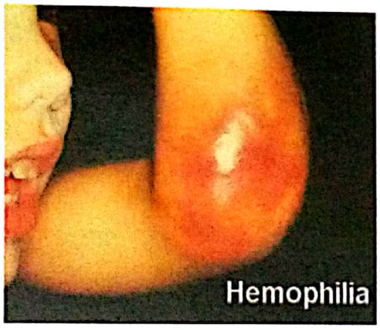
Clinical picture

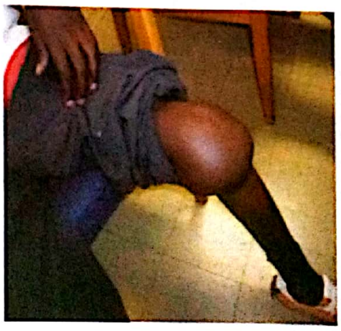
Bleeding onset

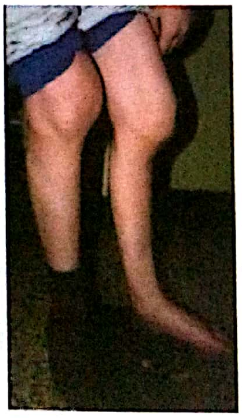
1. **Neonatal period**: circumcision is usually the first trauma points to hemophilia A
2. **Other children** presents towards the end of the first year, when they start to crawl then walk and fall over.
3. **Late age of onset** in hemophilia B.

Bleeding sites

1. **Skin**:-ecchymoses or hematoma after injections.
2. **Mucous membranes**: hematuria (in severe cases), bleeding from lip or tongue laceration.
3. **Muscles hematoma**
4. **Internal organs**:-intracranial hemorrhage
5. **Joints (Hemarthrosis)**
    - It is the hallmark of severe hemophilia.
    - It occurs with minor trauma or spontaneous
    - Repeated hemorrhage inside the joint spaces → degenerative joint changes and damage→ fixed unstable joint.







Investigations

1. **Coagulation tests: Phase 1 coagulation defect**
    - Prolonged partial thromboplastin time (PTT)
    - N.B: In hemophilia: prolonged clotting time, normal bleeding time -normal prothrombin time
2. **Coagulation factors assay**

Factor VIII (hemophilia A)

- Mild : above 5 % of normal (bleed after surgery)
- Moderate: 1-5% (bleed after minor trauma)
- Severe: less than 1% (spontaneous join/ muscle bleeds)

Factor IX deficiency (hemophilia B

Differential diagnosis of hemophilias

From acquired coagulation defects

1. Liver cell failure : clinical and laboratory evidence of liver cell failure
2. Disseminated intravascular coagulopathy: critically ill patient , fibrin degradation products(FDPs) in the blood

Treatment

General measures

1. Protection from trauma
2. Physiotherapy to preserve muscle strength (muscles are important for joint stability).
3. Avoid intramuscular injection, aspirin and non-steroidal anti-inflammatory drugs

Specific measures

1. **Replacement therapy : It aims to increasing factor VIII in the plasma to a level that stop bleeding**
    - IV infusion of recombinant factor VIII concentrate : 25-50 unit/kg every 12 hours for hemophilia A, or recombinant factor IV in hemophilia B
    - Plasma concentrate of Factor VIII in hemophilia A (or factor IX concentrate in hemophilia B) if recombinants products are unavailable
    - The amount required depends on the site and nature of the bleed
    - Prophylactic factor VIII or IX weekly to all children with severe hemophilia
2. **Desmopressin(ADH) infusion**
    - It increases factor VIII production may be of value in mild cases
    - It is of no value in hemophilia B

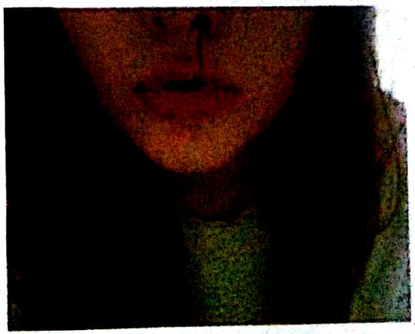
Vascular Hemophilia: Von Willebrand disease

Etiology

- Genetic: autosomal dominant: both sexes are equally affected.
- Decreased production of Von Willebrand protein which has 2 functions
    - It facilitate platelet adhesion to damaged epithelium→ defective platelet adhesion
    - It acts as a carrier protein for factor VIII, protecting it from inactivation →decreased factor VIII activity

Clinical picture: many different types the commonest is type 1 which is mild

1. Mild bleeding tendency: epistaxis, bleeding gum (may be not diagnosed until puberty?: menses)
2. In contrast to hemophilia large hematoma and hemoarthrosis are very rare



Investigations

1. Bleeding time: prolonged (decreased platelet adhesion).
2. Platelet count is normal
3. Prolonged coagulation time and partial thromboplastin time.
4. Reduced level of Von Willebrand protein and factor.

Treatment

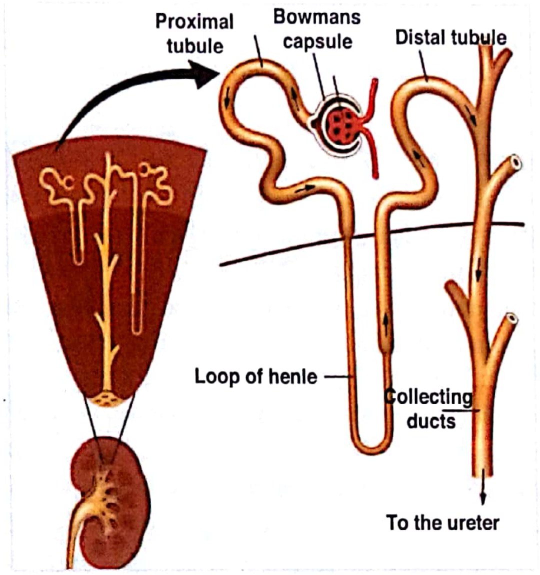
As hemophilia A.

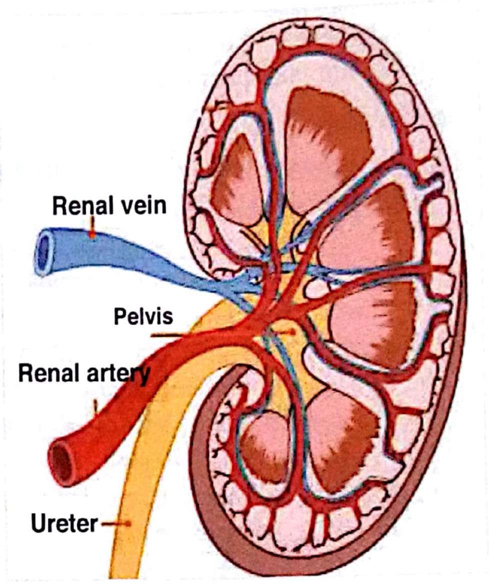
Nephrotic Syndrome

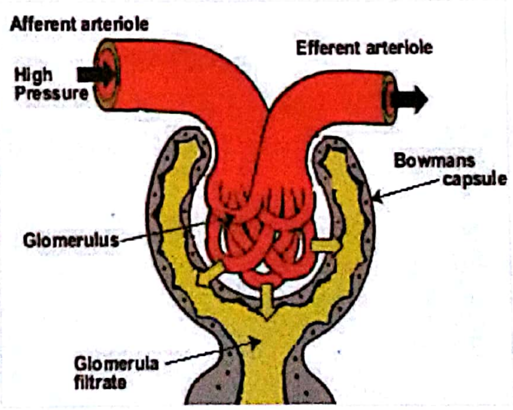
Definition

It is a syndrome characterized by:-

- **H**eavy proteinuria
- **H**ypoalbuminemia
- Generalized edema
- **H**yperlipidemia







Etiology

1. **Primary (idiopathic) nephrotic syndrome 90% of cases**
   - Minimal change nephrotic syndrome: 75 %(best prognosis)
   - Focal segmental glomerulosclerosis: 20% (poor prognosis)
   - Mesangial proliferation: 5%
2. **Secondary causes: 10%**
   - Hepatitis B and malaria.
   - Henoch Schonlein purpura
   - Systemic lupus erythematosus

× Congenital nephrotic syndrome is rare autosomal recessive disorder with bad prognosis

Minimal Change Nephrotic Syndrome

Incidence

- The commonest cause of nephrotic syndrome: 75 % of cases.
- Sex incidence: boys > girls: 2:1

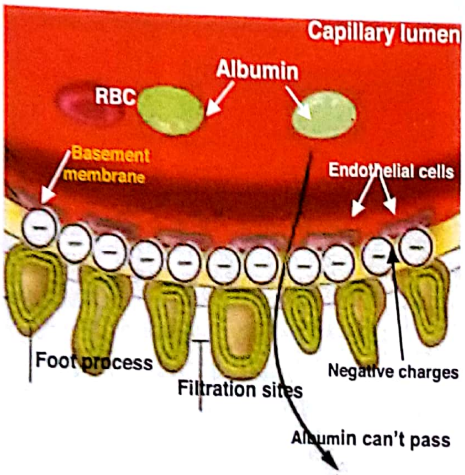
Etiology

- Idiopathic, it may be due to disturbance in T cell functions.
- It is often precipitated by viral upper respiratory tract infections.

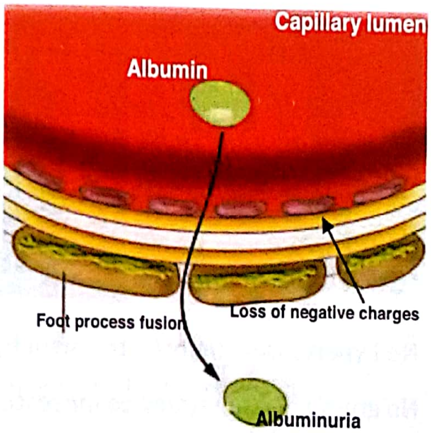
Pathogenesis

1. **Proteinuria**
    - More than 1 gram/ m² / 24 hours or urinary protein/ creatinine ratio more than 2
    - It is due to loss of negatively charged glycoproteins from the basement membrane → decrease repulsion force between albumin and basement membrane→ protein leak

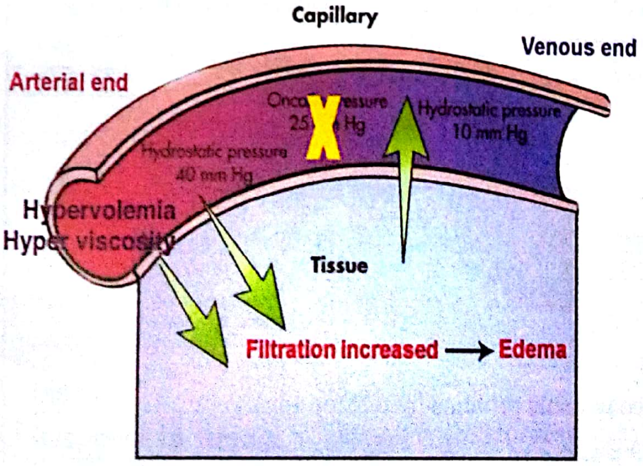
Normal

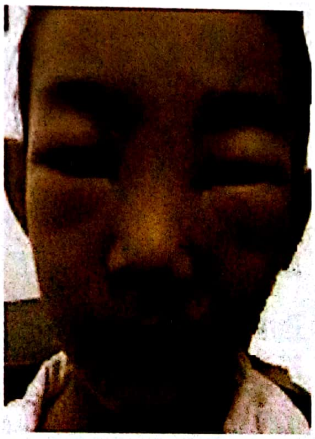


Nephrotic syndrome



2. **Hypoalbuminemia** (less than 2.5 gram %) due to proteinuria.
3. **Edema** due to Hypoalbuminemia: see kwashiorkor.



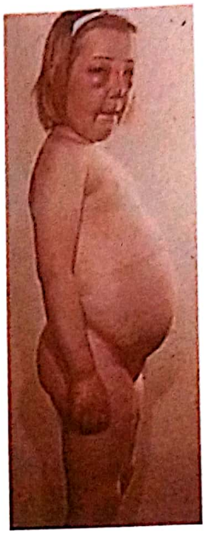


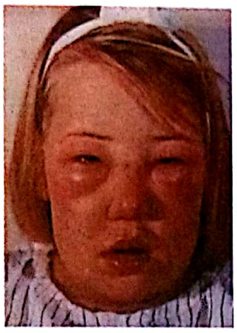
4. **Hyperlipidemia:** hypercholesterolemia more than 300 mg % and hyperglyceridemia).
It is due to reduced plasma level of lipoprotein lipase→. Diminished lipid catabolism

Clinical picture

- **Most common between 2- 6 years (the age of the first attack)**
- History of proceeding viral upper respiratory tract infections may be present.

1. **Generalized edema**
   - **Site of onset**: around the eyes.
   - **March or distribution**
     - Initially, it is more in the morning and disappears at the end of the day.
     - Later on, it affects dorsum of the hand, scrotum, lower limbs then ascites.
     - Pleural effusion occurs in severe cases.
   - **Characters**
     - Pitting
     - Massive
     - Associated symptoms: vomiting, diarrhea and abdominal pain (gut wall edema) may be respiratory distress (due to pleural effusion).

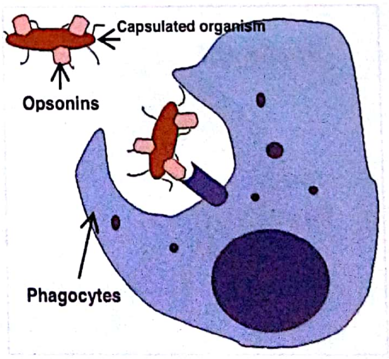


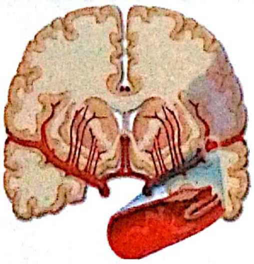


2. **No hypertension (may be transient hypertension)**
3. **No gross hematuria(may be microscopic hematuria)**

Complications

1. **Infections by capsulated organisms : the most important**
   - **Predisposing factors**
     - Loss of immunoglobulin.
     - Decreased production of opsonins that facilitate phagocytosis of capsulated bacteria→ e.g. pneumococci is the commonest
   - **Sites**: peritonitis, cellulites (skin) and septicemia.





2. **Thrombosis**
   - **Predisposing factors**:
     - Urinary losses of anticoagulants proteins (anti thrombin).
     - Increased blood viscosity.
   - **Sites**: Arterial thrombosis usually brain, limbs and splanchnic circulation.
3. **Hypovolemic shock with aggressive diuretic therapy**
4. **Complications of therapy with steroids or immunosuppressive drug e.g. infections,**
5. **Muscle wasting and growth failure**

Investigations

Laboratory

1. Heavy proteinuria
    - More than 1 gram/ m^2 / 24 hours urine collection?? (normal less than 150 mg/24 hours)
    - Spot urine protein to creatinine ratio more than 2 (normal less than 0.3)
    - **Selective proteinuria (loss of low molecular weight protein mainly albumin)**
2. Hypoproteinemia: serum albumin below 2.5 gram % (normal: 4.5-5.5 gram/d)l.
3. Hyperlipidemia: more than 300 mg % (normal: 120-220mg/dl).
4. **Serum complement (C3) and renal functions (urea and creatinine) are normal.**
5. Others: complete blood picture, urine culture and serum electrolytes

Renal biopsy

➢ **Biopsy indications**

Clinical

1. Age: less than 1year or more than 8 years.
2. Gross hematuria or persistent hypertension.
3. Children with systemic manifestations e.g. skin rash
4. Children with family history of renal disease.

Laboratory

5. Impaired renal functions.
6. Decreased serum complement.

Therapy

7. Steroid resistant: no response after 6-8 weeks of daily steroid therapy

Renal biopsy – ultrasound guided

➢ **Biopsy findings**

1. Light microscopy: no abnormalities.
2. Immunofluorescence: no abnormalities
3. Electron microscopy: fusion foot processes of epithelial cells (podocytes).

Differential diagnosis

1. **Non-minimal changes nephrotic syndrome.**

	Minimal changes NS	Non minimal change NS
Clinical		
. Age	2- 6 years	Any age
. Gross hematuria	Absent	Common
. Hypertension	Absent (may be transient)	Present
Laboratory		
. Proteinuria	Selective	Non selective
. Renal functions	Normal	May be impaired
. Complement C3	Normal	May be consumed
Biopsy	Not indicated	Indicated
Response to steroid	Sensitive (excellent response)	Resistant (poor response)

2. **Other causes of generalized edema**

Nutritional	**Hepatic**	**Cardiac**	**Allergic**
Edema site of onset			
· Dorsum of the feet	Abdomen	Lower limbs	Face
Presence of ascites			
. No ascites	Ascites	Ascites	No ascites
Associated features			
. Mental changes . Hair changes	. Jaundice . Bleeding tendency	. Neck veins congestion . Enlarged tender live	Itching Urticarial rash
Pathogenesis ↓ oncotic pressure of plasma proteins		↑Hydrostatic pressure	↑ Permeability

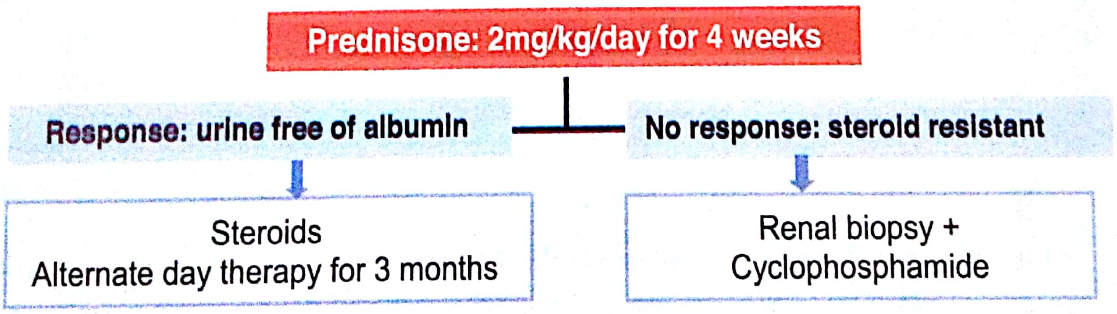
Treatment

Supportive treatment

1. **Diet**: average protein and low in fat with salt restriction
2. **Control of edema**.
   - Moderate edema: diuretics (Furosemide or chlorthizide) with caution.
   - Marked edema: intravenous albumin followed by Furosemide.

Specific treatment

1. **Steroids**
   - **Induction of remission**: **Daily therapy**
     Prednisone 2 mg/ kg/ day (60 mg/ m^2/day) divided into 3-4 doses for 4 weeks.
     - Steroid responsive: urine becomes free of albumin
     - Steroid resistant: No response after 1 month (renal biopsy is indicated)
     - **Minimal lesion type usually gives excellent response to corticosteroids**
   - **Maintenance of remission**: **Alternate day therapy**
     Prednisone 2 mg/ kg/ day is given as a single morning dose after breakfast every other day for 3 months (this minimizes steroid side effects)
   - **Relapses** is the recurrence of edema, it is treated as the initial attack but alternate day therapy is continued for longer period (6 months)
2. **Cyclophosphamide**: **in steroid resistant and in cases with frequent relapses**
   - Following finishing of steroid therapy, it is given after careful assessment of the case.
   - Leucocyte count is monitored, stop therapy if count drops below 3000/mm^3
   - Other immunosuppressant may be tried e.g. cyclosporine, methylprednisolone.


Prednisone: 2mg/kg/day for 4 weeks
Response: urine free of albumin
No response: steroid resistant
Steroids
Alternate day therapy for 3 months
Renal biopsy +
Cyclophosphamide

Treatment of complications: treatment of infections

Antibiotics: penicillin for urgent treatment of any suspected infections e.g. peritonitis and skin infections. No need for antibiotic prophylaxis

Acute Nephritic Syndrome

Definition

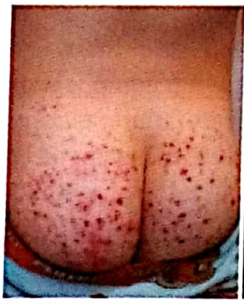
It is a syndrome characterized by:-

- **H**ematuria
- **H**ypertension
- Edema
- Renal insufficiency

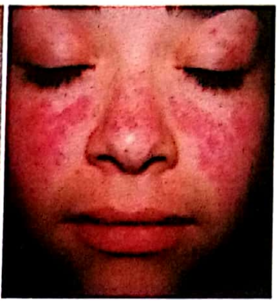
Sometimes patients may have only one or 2 of the previous features

Etiology

1. **Post-infectious** : Acute post-Strptococcal.
2. **Vasculitis**
   - Henoch-Schönlein purpura
   - Systemic lupus erythematosus.
3. **Idiopathic nephritis e.g.**
   - Membranoproliferative glomerulonephritis
   - Rapidly progressive glomerulonephritis



Henoch-Schönlein



SLE

Acute post streptococcal glomerulonephritis

Incidence

The most common cause accounts for 85 % of cases.

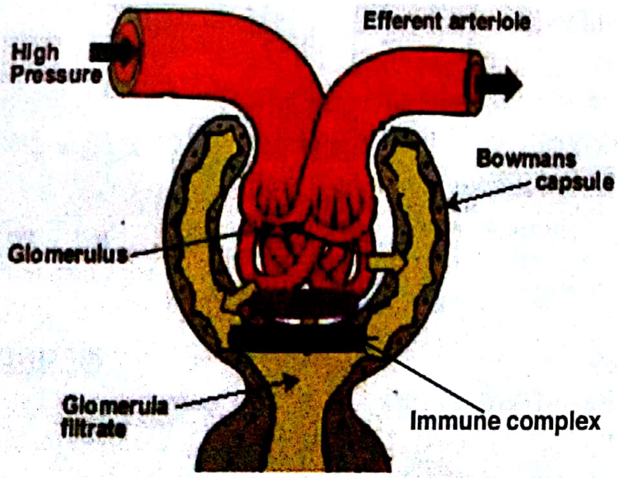
Etiology

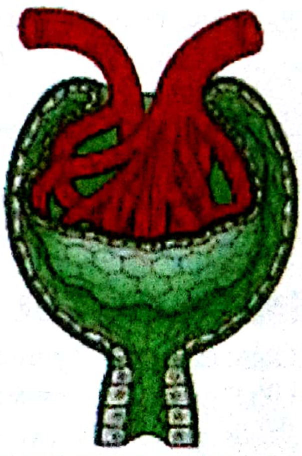
It is an autoimmune disease following group A Beta hemolytic streptococci of the pharynx or skin.

Pathogenesis

Immune complex (streptococcal Ag + antibodies + complement) is deposited in the basement membrane of the glomerular capillaries, which lead to

- o Inflammatory changes in the glomeruli→glomerular injury (hematuria)
- o Proliferation of epithelial lining of bowman's capsule →decreased glomerular filtration → oliguria →Na and water retention → hypervolemia →edema and hypertension





Proliferation of the epithelial cells

Clinical presentations

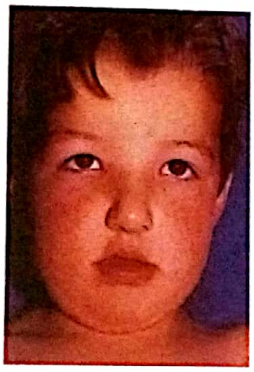
History

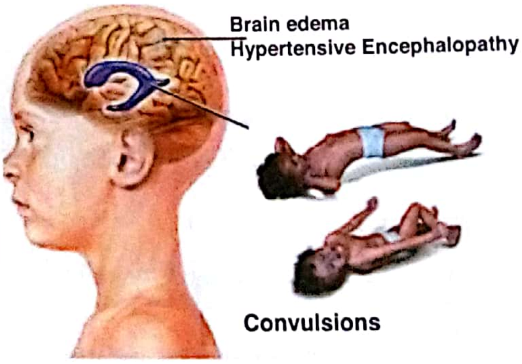
1. Urinary symptoms (the most frequent): gross hematuria and may be oliguria.
2. General symptoms: low grade fever and headache.
3. History of preceding streptococcal infection of the pharynx or skin. Latent period is 10 days after respiratory infections, 21 days after skin infections

Examination

1. Hypertension
2. Edema
   - Acute onset
   - Mild
   - Puffy eye lids and lower limbs edema
3. Patents may present with complications.
   - Hypertensive heart failure: tachypnea, tachycardia and tender liver
   - Hypertensive encephalopathy: altered consciousness and or convulsions
   - Acute Renal failure (rare): oliguria and anuria in severe cases.

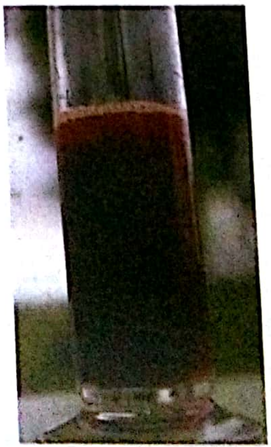
× Most cases are mild with complete recovery, others may pass un noticed





Investigations

- **Laboratory**
  1. Urine analysis
     - Hematuria and Red cell cast
     - Very mild proteinuria
  2. Low serum complement : C3
  3. Blood urea nitrogen and creatinine may be elevated
  4. Metabolic acidosis may be present with acute renal failure
  5. Evidence of recent streptococcal infection :
     - Anti Streptolysin O antibodies may increase
     - Not all beta streptococci produce Streptolysin O
     - Skin or throat cultures may be positive
- **Imaging**: renal ultrasound may show increase renal echogenicity.



Gross hematuria

Differential diagnosis

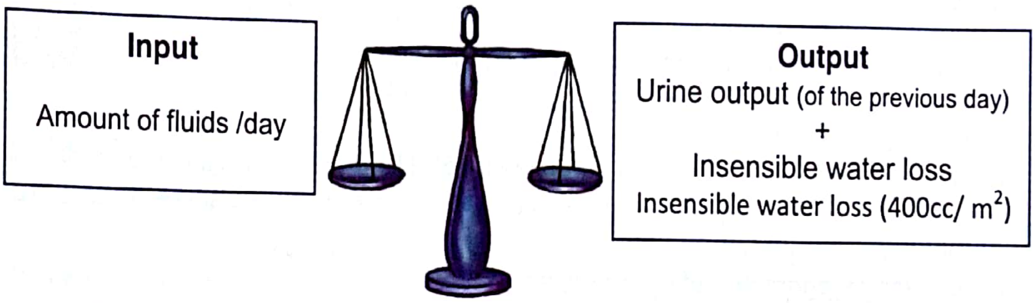
1. Other causes of hypertension. Page 89
2. Other causes of generalized edema: Page 206
3. Other causes of hematuria. Page 220

Treatment

- **Home management**: for most cases, more than 95% of cases will recover completely within few weeks and even without therapy.
- **Hospitalization**: for cases complicated with severe hypertension, heart failure or renal failure

Supportive treatment

1. **Rest**: indicated only during the oliguric phase of illness (first week).
2. **Diet**
   - High carbohydrate diet.
   - Salt, protein and potassium restriction during the oliguric phase and in presence of complications e.g. hypertension and marked congestion
   - Fluid balance


Input
Amount of fluids /day
Output
Urine output (of the previous day)
+
Insensible water loss
Insensible water loss (400cc/ m^2)

Specific treatment

1. **Control of edema**
   - In most cases edema subsides spontaneously by the end of the first week. Fluid restriction and salt restriction during the first week are usually sufficient.
   - Diuretics e.g. Furosemide, in some cases.
2. **Control of hypertension** : when diastolic pressure exceeds 95 mmHg, usually one oral antihypertensive drugs is sufficient
   - Captopril (ACE: **A**ngiotensin **C**onverting **E**nzyme inhibitor) 0.5-1 mg/kg/day divided into 3-4 doses).
   - B blockers
3. **Penicillin** for eradication of any streptococcal infection (10 days oral course).

Treatment of complications

1. **Renal failure**: diuretics, fluid restriction, treatment of acidosis and dialysis if indicated.
2. **Heart failure**
   - Preload reducing agents: Diuretics
   - After load reducing agents: Converting enzyme inhibitors e.g. Captopril.
   - Inotropes: if needed, Dopamine not digitalis (digitalis is eliminated by the kidney).
3. **Hypertensive encephalopathy**: I.V. Diazoxide.

Prognosis

1. Complete recovery in 95% of cases (within 6-8 weeks).
2. Recurrence is extremely rare

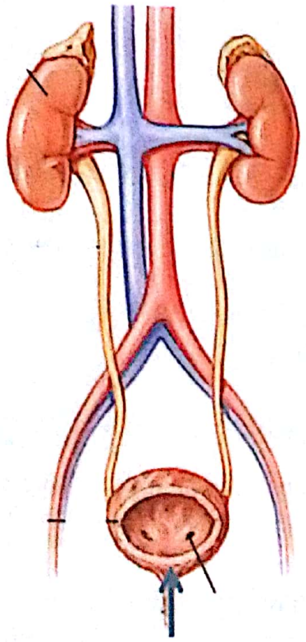
Urinary Tract Infections

Incidence

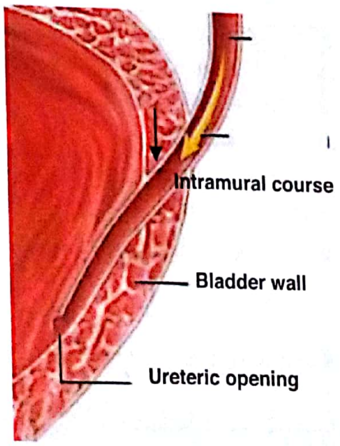
- Girls to boy's ratio is 3:1 (girl's urethra is shorter and closer to the anus).
- In neonates and early infancy boys are more affected

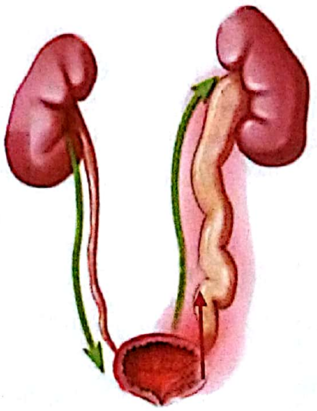
Etiology

1. **Organism**
   - **Gram $^{-}$Ve**
     E coli (the commonest cause 80% of cases).
     Proteus, Klebsiella and Pseudomonas
   - **Gram $^{+}$Ve** Staphylococci (coagulase $^{-}$ Ve) streptococcus fecalis.
2. **Source**: fecal flora.
3. **Routes**
   - Ascending: most common usually in older children.
   - Hematogenous: less common usually in neonates.
4. **Predisposing factors**(stasis)
   - **Vesicoureteral reflux:** reflux of urine from the bladder to the ureters and renal pelvis. →ureteric dilatation (stasis →infection) renal damage from high bladder voiding pressure
   - **Congenital anomalies of urinary system.**
   - **Incomplete bladder emptying** due to infrequent voiding or constipation (loaded rectum).



Ascending route





Vesicoureteral reflux

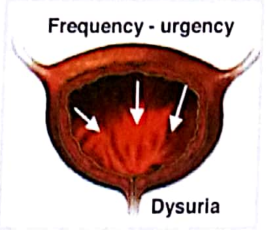
Types

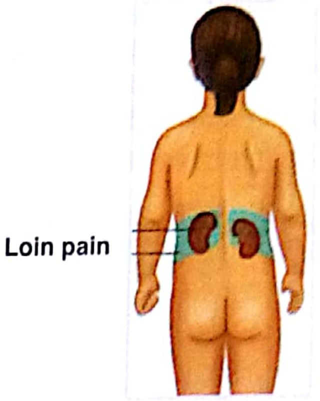
1. Lower urinary tract infection: cystitis
2. Upper urinary tract infection: pyelonephritis
   It is more serious (may damage the growing kidney by forming a scar, predisposing to hypertension and to chronic renal failure if scaring is bilateral)

Clinical picture

Neonates and infants: non-localizing signs

1. Fever, Failure to thrive
2. Poor feeding and Prolonged neonatal jaundice.
3. Lethargy or irritability.
4. Vomiting, diarrhea, abdominal pain and may be distention





Older children

1. Cystitis
    - Dysuria, frequency, urgency, dripping and abdominal pain.
    - Hematuria (with hemorrhagic cystitis or urethritis).
    - Secondary nocturnal enuresis.
2. Pyelonephritis: high fever, rigors (chills), vomiting and loin or flank pain.

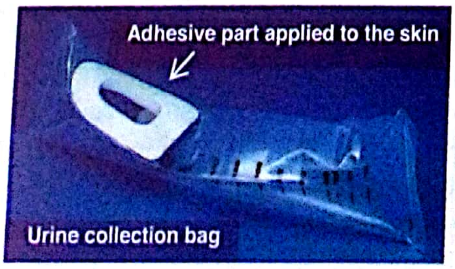
Investigations

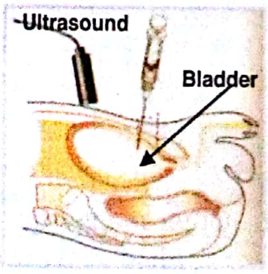
1. Urine analysis

- More than 10 WBC /high power field (pyuria) is suggestive of infection
- It is not reliable because:
    - Urinary tract infection may be present without pyuria e.g. with previous antibiotic therapy
    - Pyuria may be present without infection e.g. febrile illness or nephritis

2. Urine culture is the best investigation for urinary tract infections.

- **Urine collection for culture**
    - Midstream clean catch sample.
    - Suprapubic aspiration using ultrasound guidance (of choice)
    - Bladder catheterization.
    - Urine bag applied to the perineum : not recommended (contamination)
- **Positive culture**
    - Culture of > 10^5 bacterial colonies in a freshly voided clean catch or catheterized urine specimen.
    - Any bacterial growth in a urine specimen obtained by suprapubic aspiration
    - × The presence of more than one organism or lower counts →contamination

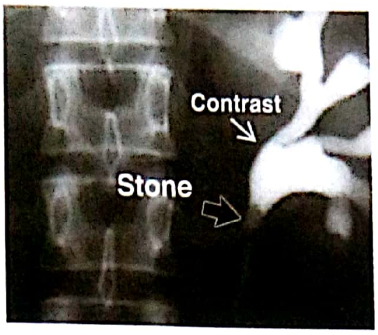




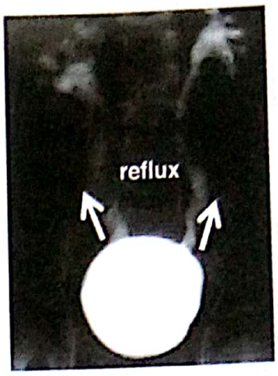
3. CBC: leukocytosis, and elevated C reactive protein: (higher levels with pyelonephritis

4. Imaging Investigations: in recurrent urinary tract infection

- **Ultrasound**: It is the INITIAL imaging procedure: exclude obstructive uropathy, stones and structural abnormalities of the urinary system.
- **Renal scan** (renal scintigraphy) for detection of renal scars
- **Voiding cystourethrography** to exclude lower urinary tract anomalies e.g. vesicoureteral reflux and posterior urethral valve.
- **CT scan of the abdomen and pelvis**
- **Intravenous pyelography (IVP)** (invasive, not recommended)



IVP



Voiding cystourethrography

Treatment

Acute cases

1. **Pyelonephritis: very serious, may lead to renal scar→ renal insufficiency later on**
   - Hospitalization
   - Drugs: broad spectrum antibiotics e.g. 3rd generation cephalosporin
     Treatment is adjusted according to the results of urine culture and sensitivity
   - Route: IV initially then shift to oral therapy after 5 days if the patient is improving
   - Duration: 10-14 days
   - Repeat culture after 48 hours: Urine should be sterile with adequate therapy.
   - Low dose oral prophylaxis till voiding cystourethrography result.
2. **Cystitis**
   - Drugs: Amoxicillin 50 mg/kg/ day or co-trimoxazol.
   - Route: oral
   - Duration: 7-10 days

Recurrent cases: after eradication of infection the following should be done

1. **Long term antibiotic prophylaxis**
   One of the following drugs may be given once daily for several months:-
   - Trimethoprim-sulphamethoxazol
   - Nitrofurantoin : 2 mg/kg/day
   - Macrodantin: 1.2-2.4 mg/kg/day
   - Oral cephalosporins
2. **Other measures**
   - Fluid intake should be adequate.
   - Frequent day time voiding and complete voiding at bed time
   - Prevent or treat constipation.
   - Perineal hygiene.
3. **Treatment of reflux: surgery may be needed for severe cases**

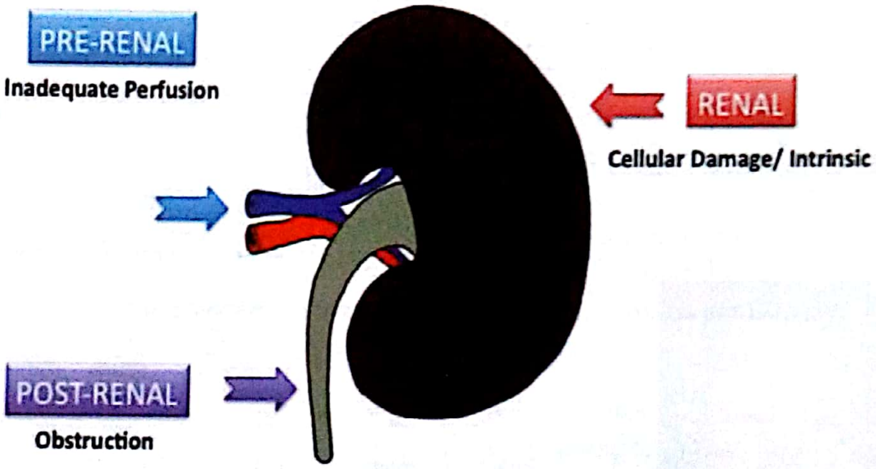
Acute kidney Injury : Acute Renal Failure

Definition

It is a **sudden, potentially reversible** inability of the kidney to maintain normal body chemistry and fluid balance. It is usually accompanied by oliguria (urine output <0.5mL/kg/h or <1mL/kg/h in neonate)

Pediatric RIFLE (pRIFLE) criteria*:* is a system used for the detection and classification of acute kidney injury and for correlation with clinical outcomes:

R = risk for renal dysfunction (serum creatinine rises x1.5 initial value).
I = injury to the kidney (serum creatinine rises x 2 initial value).
F = failure of kidney function (serum creatinine rises x 3 initial value).
L = loss of kidney function.
E = end-stage renal disease



Etiology

Pre-renal: renal hypo perfusion: functional failure: commonest cause in children

1. Hypovolemia (dehydration due gastroenteritis – diabetes inspidus or any other cause).
2. Hypotensive (shock due to any cause e.g. septic shock or cardiogenic shock).
3. Hypoxemia e.g. neonatal hypoxia (birth asphyxia)

Renal: organic =renal disease= organic failure

1. Tubular: acute tubular necrosis due to prolonged ischemia (persistence of prerenal causes)
2. Glomerular : different types of glomerulonephritis - severe acute pyelonephritis
3. Vascular: Hemolytic uremic syndrome : discuss P: 204
4. Interstitial : interstitial nephritis by nephrotoxic drugs
    - Non-steroidal anti-inflammatory drugs and antibiotics especially aminoglycosides
    - Immunosuppressive drugs and heavy metals
    - Radiographic contrast media (e.g. IVP and CT scans with contrast)

Post-renal causes =obstructive renal failure

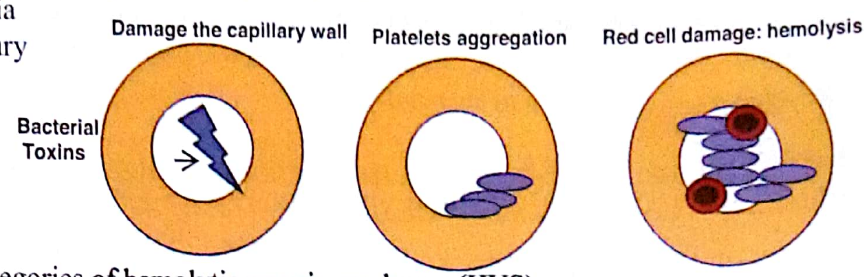
1. Congenital obstruction (posterior urethral valves in male).
2. Acquired obstructive (bilateral stones-clots).

Hemolytic uremic syndrome

An important cause of AKI in infants and children

It is a triad of

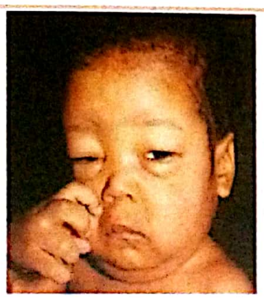
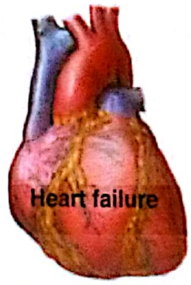
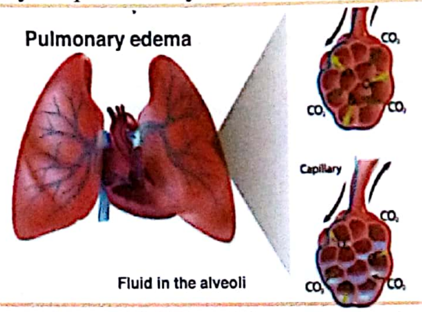
- Hemolytic anemia with fragmented erythrocytes,
- Thrombocytopenia
- Acute kidney injury



There are 3 broad categories of hemolytic uremic syndrome (HUS)

- Typical HUS, diarrhea positive (D +) HUS, following diarrhea caused by certain strains of E. coli
- Atypical HUS, usually diarrhea negative (D–) HUS, due to inherited complement system abnormalities
- Secondary HUS, secondary to certain drugs, malignancy, post transplantation

Pathogenesis and Clinical picture

Oliguria or anuria: urine output <0.5L/kg/h or <1mL/kg/h in neonate)		
1	**Fluid retention**	Edema and weight gain Hypertension Heart failure and may be pulmonary edema
		 
2	**Retention of acidic wastes**	Metabolic acidosis → deep rapid breathing
3	**Retention of potassium**	Hyperkalemia →cardiac arrhythmias
4	**Retention of water more than Na and calcium**	Dilutional Hyponatremia and Hypocalcemia→ convulsions
5	**Retention of urea and creatinine**	Hyperosmolarity and Brain edema→ uremic encephalopathy and coma
6	Hypotension, tachycardia, and dry mouth may suggest prerenal failure. Full bladder, a poor urinary stream, may be found in post renal failure	

Investigations

1. **Urine analysis**
    - Low urine sodium (high aldosterone)and a concentrated urine denote prerenal failure
    - Casts and a high urine sodium level denote actual intrinsic renal failure
    - Others: blood ,protein and casts may be present
2. **Renal functions**: increased urea (N: 20-40 mg/dl) and creatinine (N: 0.5-1.5 mg/dl)
3. **Electrolytes:** hyperkalemia, hyponatremia and hypocalcemia.
4. **Blood gas:** metabolic acidosis (low pH-low bicarbonate)

5. **Renal ultrasound**
   In renal causes (renal injury): large echo bright kidneys
   In post renal cause (obstructive): dilated pelvi calyceal system or calculi
6. **Renal biopsy is indicated when**
   - Renal function is deteriorating rapidly and the etiology is not certain.
   - Nephritic/nephrotic presentation.

Further additional investigations depend on clinical presentation and suspected etiology

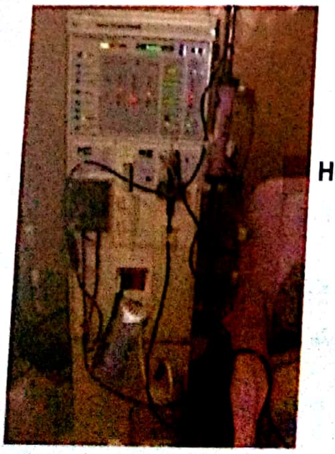
Treatment

Prevention is possible by avoiding unnecessary use of nephrotoxic drugs and early recognition of medical condition known to cause acute renal failure e.g. dehydration

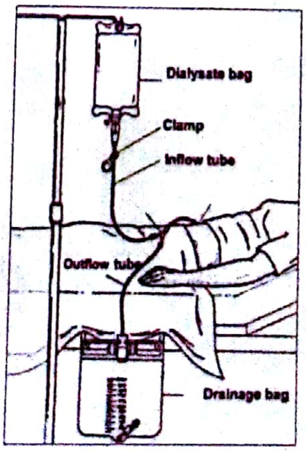
Conservative measures

1. **Correction of the cause , if possible**
   - Treatment of pre-renal cause: fluid, blood or plasma transfusion.
   - Treatment of post renal cause: catheter or nephrostomy tube.
   - If renal cause: diuretics to increase urine output.
2. **Treatment of oliguria or anuria**
   - Volume expansion: in all cases except those with fluid overload: Ringer lactate or normal saline 20 ml/kg over 20-30 minutes.
   - Diuretic therapy: in cases with volume overload and those who failed to respond to volume expansion:
     Furosemide: 2 mg/kg IV, if no response within 1 hour, second dose of 10 mg/kg may be given. If no response → Mannitol 20% : 5 ml/kg IV drip over 30 minute
   - Dopamine infusion (3-5 μ gm/kg/minute): in all cases except dehydrated ones.
   - Fluids balance : intake = urine output + insensible water loss (400 ml/ m$^{2)}$
3. **Treatment of metabolic acidosis**: for severe acidosis pH below 7.2
   - Sodium bicarbonate 5% 4 ml/kg IV over 10 minutes aiming to raise pH above 7.2.
4. **Treatment of hyperkalemia: serum k above 6 mEq /L is serious→ cardiac arrhythmia**
   - Avoid potassium intake.
   - Ca gluconate 10% 0.5 ml /kg slow IV over 10 minutes (cardiac protection : antagonize the cardio toxic effect of hyperkalemia on the heart)
   - IV glucose 25% 2ml/kg + insulin 1 unit/20 ml glucose 25% (shift K intracellular).
   - Sodium bicarbonate: 4ml/kg over 10 minutes IV to drive potassium intracellular.
   - Peritoneal dialysis in persistent hyperkalemia
5. **Treatment of hypertension, convulsions and associated infections.**

Dialysis (peritoneal dialysis or hemodialysis) if conservative measures failed



Hemodialysis machine



Peritoneal dialysis

Chronic kidney disease

Definition

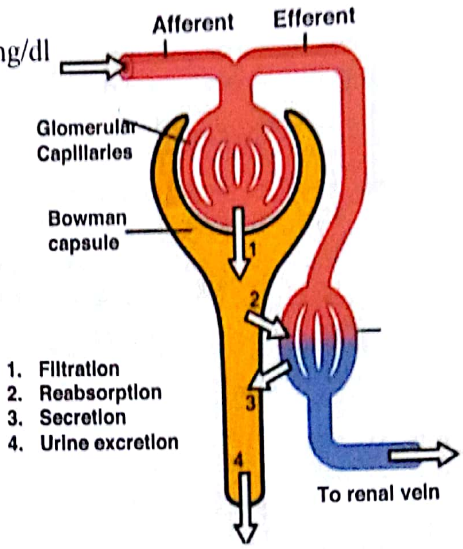
Chronic kidney disease (CKD) occurs when there are **irrecoverable**, bilateral abnormalities of the renal parenchyma.

Diagnosis of pediatric CKD is based on fulfilling one of the following clinical criteria

- GFR of less than 60 mL/min per 1.73 m^2 for more than 3 months
- GFR greater than 60 mL/min per 1.73 m^2 that is accompanied by evidence of structural of damage or markers functional kidney abnormalities e.g. proteinuria, renal tubular disorders, or pathologic abnormalities detected by histology or by imaging.

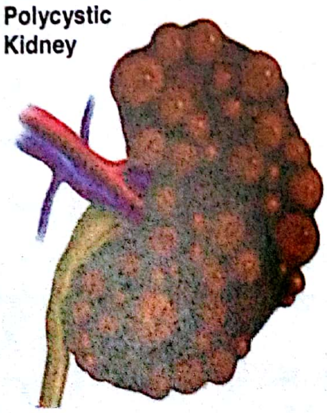
Assessment of GFR (glomerular filtration rate)

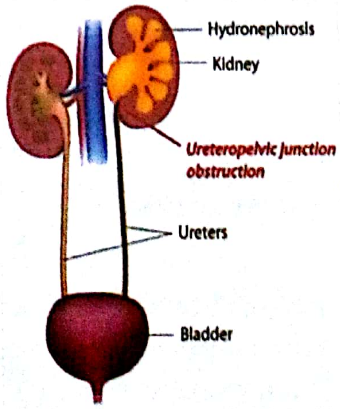
- GFR assessment in children is much better than a simple plasma creatinine level.
- GFR can be assessed in children from the formula:
  GFR (mL/min/1.73m^2)=
  Height in centimeters X 0.55) / plasma creatinine in mg/dl
- GFR differs according to the age
  - **Newborn: 40-80 ml/min/1.73 m^2**
  - **Infants: 80-100 ml/min/1.73 m^2**
  - **Children and young adults: 100-120 ml/min/1.73 m^2**

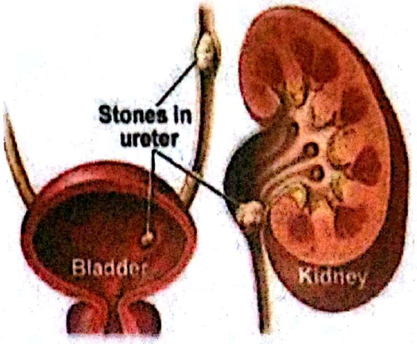


Etiology

- **Infants and young children:**
  1. Genetic and cystic kidney diseases: e.g. polycystic kidney disease, nephronophthisis.
  2. Congenital urinary tract malformations e.g. kidney hypoplasia/dysplasia, obstructive uropathy e.g. posterior urethral valves in males,
  3. Neglected, untreated pyelonephritis
- **Older children:**
  1. Glomerular disease e.g. glomerulonephritis, non-minimal change nephrotic syndrome, familial and inherited nephropathies







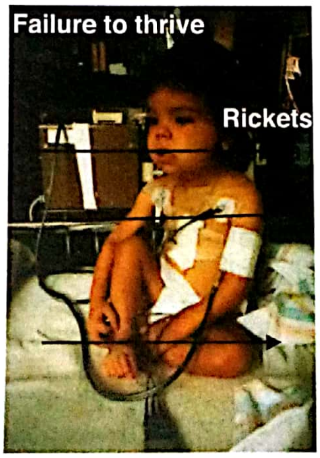
Diagnosis of chronic kidney disease

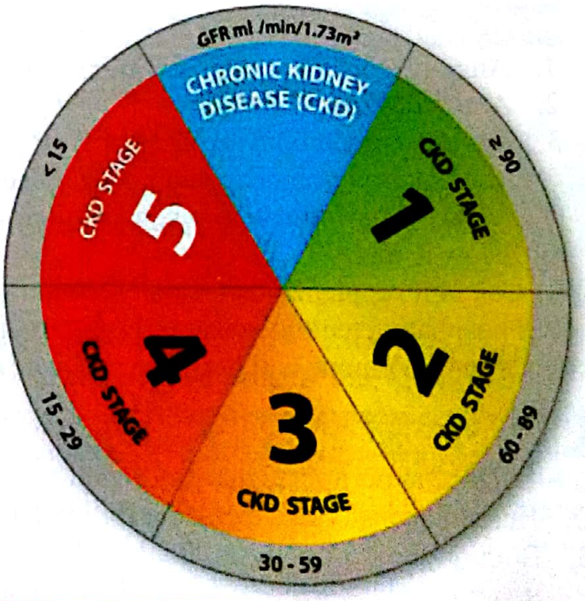
CKD is suspected in the following conditions

1. Bilateral renal defects on antenatal ultrasound scans.
2. Bilateral renal defects on ultrasound or renal scintigraphy scans e.g. for urinary tract infections (UTI).
3. When the GFR is below the normal range for age.
4. Persistent proteinuria
5. A family history of CKD or inherited kidney diseases.
6. Hypertension.
7. Previous acute kidney injury (AKI).

Staging of chronic kidney disease

Stage	GFR (mL/min/1.73 m^2	Features
1	≥ 90	Renal parenchymal disease is present
2	60-89	Usually no symptoms , but may develop biochemical abnormalities at the lower end of GFR range
3	30-59	Biochemical abnormalities and anemia. Poor growth and appetite may develop
4	15-29	Symptoms more severe
5	< 15	Renal replacement therapy is needed





Clinical manifestations

1. Polydipsia and polyuria
2. Poor nutritional intake and short stature
3. Pallor (anemia), lethargy, nausea
4. ***B***ony abnormalities from renal osteodystrophy
5. ***B***lood pressure is elevated (Hypertension)
6. ***B***leeding tendency
7. Associated infections and reduced immunity
8. Asymptomatic in Mild cases

Investigations

Laboratory

1. Urine analysis: poor urine concentrating ability, proteinuria, haematuria….etc. depending on the cause of CKD.
2. Complete blood count: anemia, evidence of associated infection……
3. Serum calcium (low), phosphorous (elevated), sodium (abnormal levels), potassium (elevated)and blood pH (metabolic acidosis)
4. Complement C3 and C4 levels, anti-nuclear antibody for systemic diseases e.g. lupus
5. DNA study for genetic mutations (e.g. nephronophthisis which is the most common genetic cause of ESRD in the first three decades of life).

Imaging

1. Ultrasound: The kidneys are usually small (except in certain conditions e.g. advanced obstructive uropathies and polycystic kidney diseases),

Renal biopsy: should be avoided in advanced CKD (small atrophic kidneys it will be of no value)

Treatment

Aims of management of CKD

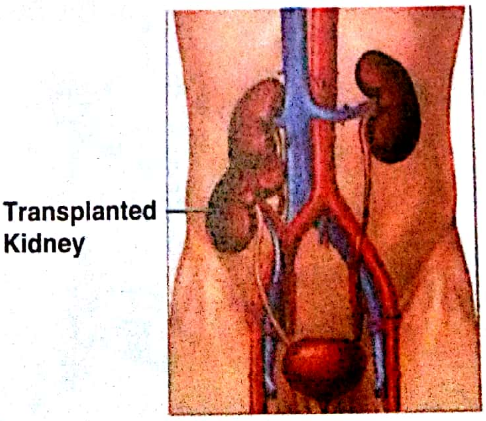
1. Slow progression.
2. Prevent biochemical and hematological abnormalities.
3. Maintain normal growth and development.
4. Preserve the limb vasculature as veins may be needed for hemodialysis (fistula formation)
5. Screen at risk family members when inherited/genetic kidney disease is the cause

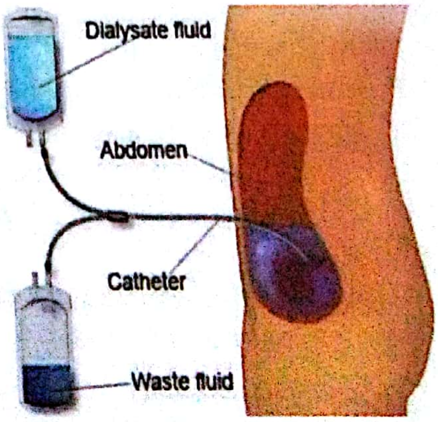
Early stages of CKD: Conservative Therapy

1. Angiotensin-converting enzyme inhibitor to reduce proteinuria
2. Antihypertensive drugs.
3. Decrease blood lipid levels.
4. Anemia: erythropoietin and iron supplementation.
5. Acidosis: bicarbonate supplementation.
6. A low K diet.
7. Calcium supplementation and vitamin D for bone disease
8. Phosphate retention needs early dietary intervention and phosphate binding agents.
9. Growth hormone and balanced adequate diet may improve the short stature.

Stage 5 CKD: Renal Replacement Therapy (RRT)

1. Long term peritoneal dialysis is preferred in children and especially in young infants.
2. Hemodialysis is also available for long term RRT.
3. Both methods of dialysis should only be used till a renal transplant is available. Renal transplantation is the best treatment for end stage renal disease.





Nocturnal Enuresis

Definition

Repeated involuntary urination, at night, beyond the expected age of bladder control (above the age of 5 years).

Incidence

- It is the most common type
- 15-20% of children are at the age of 5 years and 5% at the age of 10 years, and 1-2% of 15 year olds
- 3 times more common in boys than in girls- more common in the first born child

Etiology and types

Primary enuresis (80% of cases)

- Enuresis in a child who has never attained bladder control.
- It is due to maturational delay in bladder control (the commonest cause), strong family history is present in 20% of cases.
- Some children have loss of the normal nocturnal rise of antidiuretic hormone (ADH) production, resulting in an increase in nocturnal urine production
- Children who bed wet have deeper sleep and difficult walking,

Secondary enuresis (20% of cases)

- Enuresis in a previously trained child (a period of at least 6 months bladder control is essential before considering secondary enuresis).
- It is due to emotional upset (the commonest cause), urinary tract infection and polyuria

Management

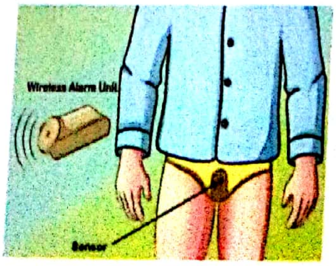
- × Attempts to treat children less than 7 years of age are often unsuccessful.
- × Primary nocturnal enuresis has a high rate of spontaneous remission, 10–15 % of children will see a resolution of bed wetting each year with no treatment.

Simple measures in children above 5 years

1. Explain to the parent and child that the problem is common and beyond conscious control so punishment should be avoided.
2. Fluid restriction after dinner.
3. Let the child urinate before sleep, then wake the child up by night to urinate.
4. Rewarding for should be given to good behavior e.g. passing urine before sleep
5. Star chart for dry nights

Alarm device: the treatment of choice: in children not responded to simple measures

It gives a ring immediately at the beginning of wetting. This helps the child to wake at the sensation of a full bladder.



Drug therapy in children above 6 years

1. Desmopressin (vasopressin analog) single night dose (orally).
2. Anticholinergic drugs to increase bladder capacity. Not commonly used because of side effects

Hematuria

Definition

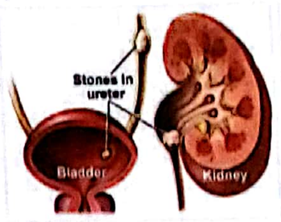
The presence of blood in urine.

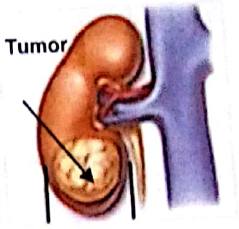
Classification

- **According to the amount**
    - Gross hematuria: visible to the naked eye.
    - Microscopic hematuria: more than 10 RBCs /high power field.
- **According to origin: renal (glomerular or extra renal (urological)**

Etiology

- **Glomerular**
    1. Acute nephritis: enumerate causes Page 207
    2. Chronic glomerulonephritis.
    3. Familial nephritis.
    4. Hemolytic uremic syndrome.





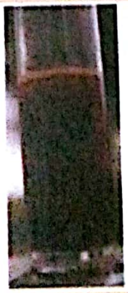
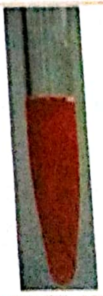
- **Non Glomerular**

  Urological
    1. Urinary tract infections.
    2. Urinary stones and hypercalcinuria.
    3. Urinary tract trauma or trauma to the genitalia.
    4. Urinary tract tumors.
    5. Drugs e.g._cyclophsamide and exercise

  Hematological
    1. Coagulopathies.
    2. Thrombocytopenic purpura
    3. Sickle cell anemia.

Clinical differentiation

1. Glomerular or non-glomerular

Glomerular (renal) hematuria	Lower urinary tract hematuria
Brown urine 	Red urine 
Presence of red cell cast	No red cell cast
Deformed red cell (as they pass through the basement membrane)	Not deformed red cells

2. Clinical picture that suggest the cause: discuss

Investigations of the cause e.g. investigations of nephritis, urinary tract infection

Hydrocephalus

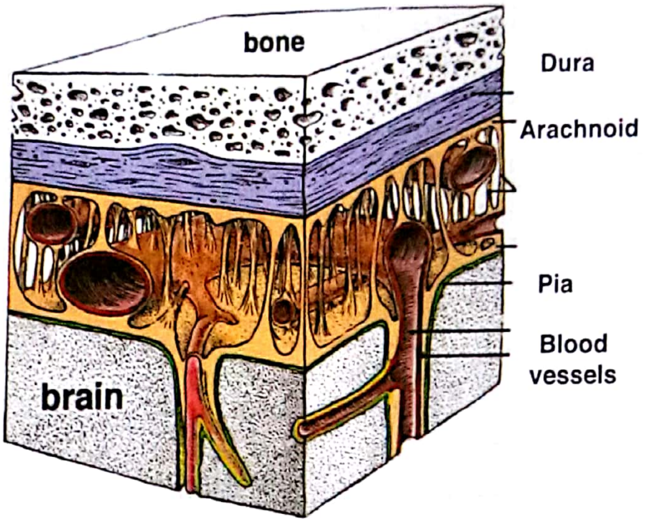
CSF circulation

1. **Secretion**

   Choroid plexus in the ventricles (lateral ventricle mainly)

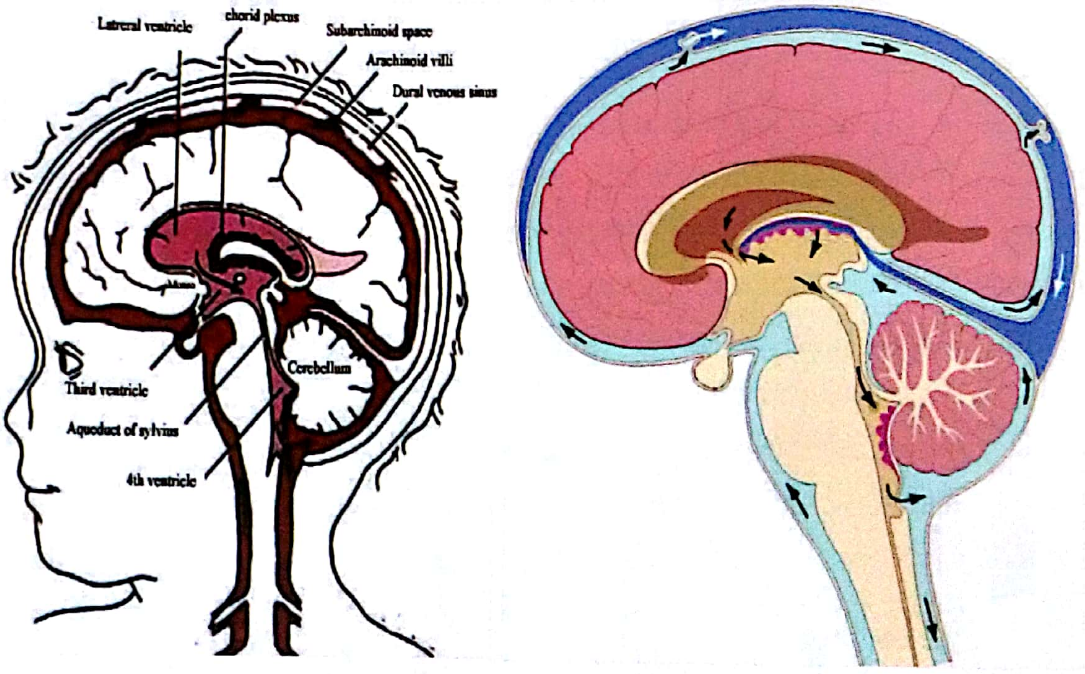
2. **Circulation**

   Lateral ventricle
   ↓
   Foramina of Monro
   ↓
   3rd ventricle
   ↓
   Aqueduct of sylvius
   ↓
   4th ventricle
   ↓
   Foramen of Luschka and Magendie
   ↓
   Subarachnoid space



3. **Reabsorption**

   CSF is reabsorbed into venous circulation from subarachnoid spaces by arachnoid villi



CSF circulation

Definition

Dilatation of the ventricular system due to either: obstruction of CSF *flow* within the *ventricular system* or impairment of its *absorption* within the *subarachnoid space*.

Etiology and types

1. **Obstructive hydrocephalus**
   Obstruction of the CSF flow within the ventricular system.

2. **Non obstructive (communicating hydrocephalus)**
   No obstruction in the CSF flow within the ventricular system but ventricular dilatation occurs due to impaired absorption of CSF within the subarachnoid space.

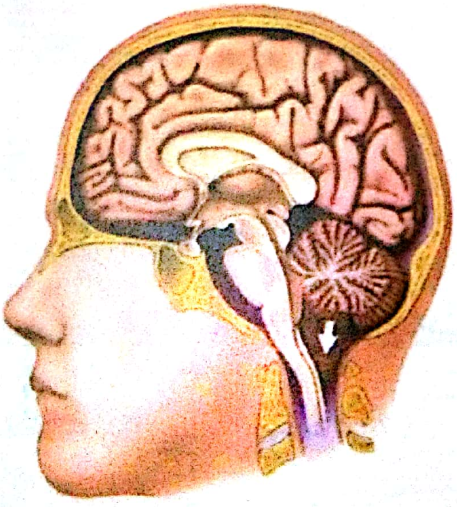
Obstructive (non- communicating) hydrocephalus

1. **Congenital**
   - Aqueduct stenosis(the commonest cause): congenital stenosis or due to toxoplasmosis
   - Dandy Walker malformation
     Agenesis of the cerebellar vermis→Obstruction at foramina of Luschka and Magendie→cystic dilatation of the 4th ventricle.
   - Vein of Galen malformations.
2. **Acquired**
   - **Traumatic**: intraventricular hemorrhage
   - **Inflammatory**: post meningitic gliosis
   - **Neoplastic**: posterior fossa tumors e.g. medulloblastoma

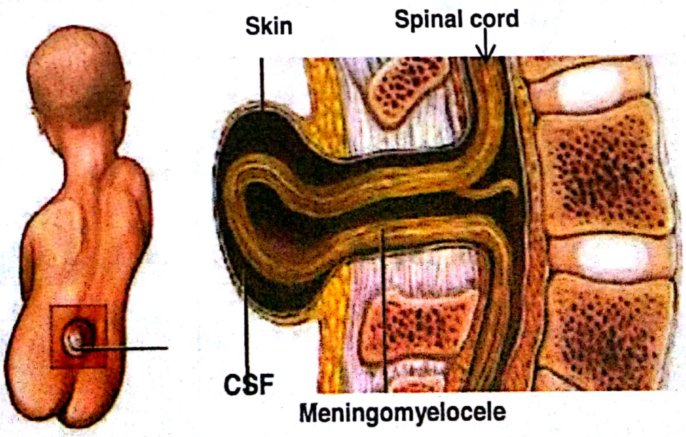
Non obstructive (communicating)hydrocephalus

1. **Congenital: Arnold- Chiari malformation**
   - There is Failure of pontine flexure development→ downward displacement of medulla and cerebellum→ obstruction of subarachnoid space around the brain stem usually.
   - It is commonly associated with meningocele or meningomyelocele.

2. **Acquired**
   - **Traumatic**: subarachnoid hemorrhage.
   - **Inflammatory**: post meningitic gliosis: pneumococcal, tuberculous.
   - **Neoplastic:** choroid plexus papilloma →overproduction of CSF



Chiari malformation



Meningomyelocele

Clinical picture

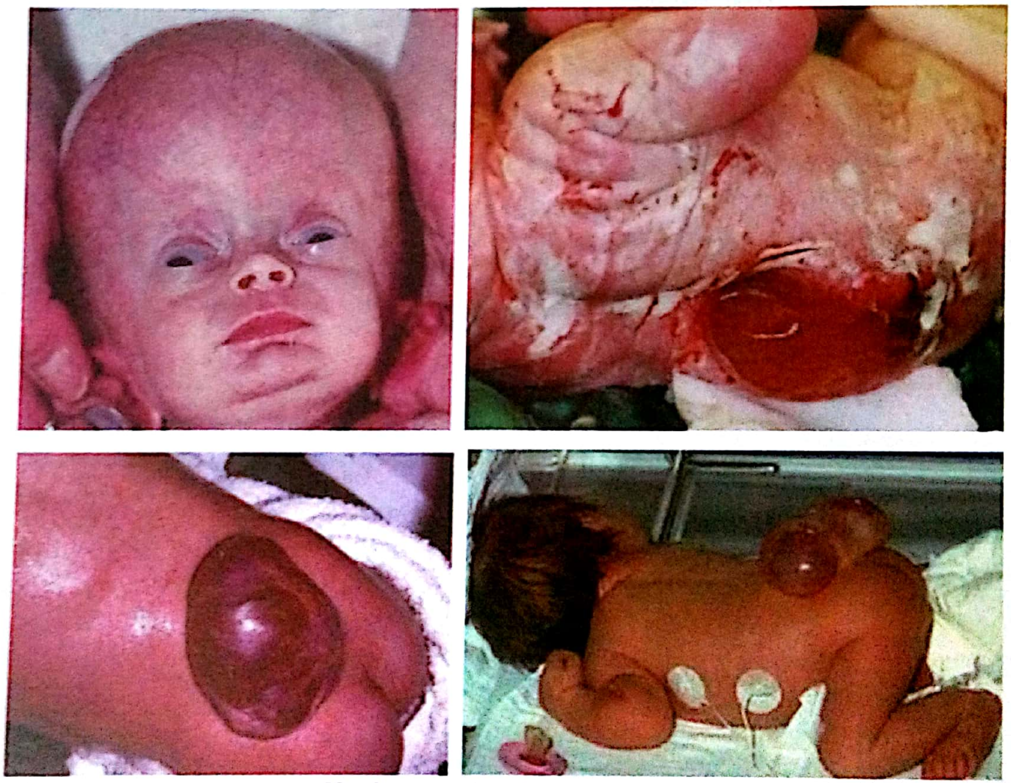
Before closure of sutures and fontanels (in infancy)

General examination

1. **Head examination**
    - Circumference: progressive increase in all skull diameters.
    - Scalp skin: thin and shiny.
    - Scalp veins: prominent.
    - Anterior fontanel: widely opened.
    - Sutures: widely separated.
    - Face: globular and prominent forehead
    - Eye: sunset appearance (downward displacement of the eyes due distortion of nerve supply
2. **Back** For any swellings: meningocele or Meningomyelocele

Neurological examination

1. **Motor system**
    - Tone: spasticity of limbs (compression on motor area, may be hypotonia with meningomyelocele)
    - Power: for evidence of paralysis.
2. **Reflexes**: exaggerated.
3. **Cranial nerves**: optic nerve atrophy in chronic cases.



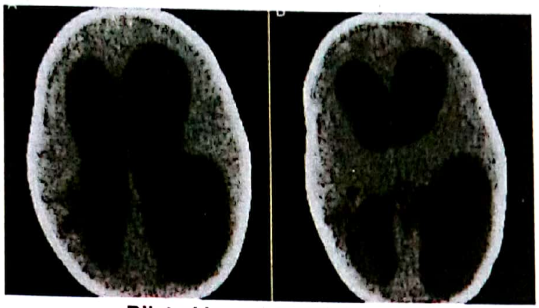
Meningomyelocele

After closure of sutures (older children)

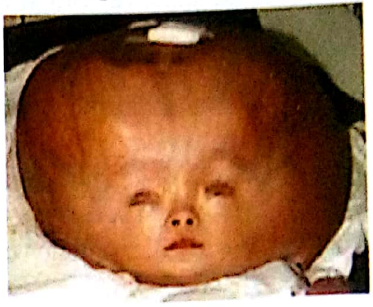
1. Head enlargement is less evident because sutures do not separate.
2. Neurological
    - Signs of increased intracranial tension are marked
    - Variable neurological deficits (spasticity, ataxia…)

Investigations

1. CT scan (the most important): dilatation of the ventricular system
    - Obstructive hydrocephalus: dilatation only proximal to the site of obstruction
    - Communicating hydrocephalus: all ventricles are dilated
2. Hydrocephalus may be diagnosed on antenatal ultrasound screening.



Dilated lateral ventricles



Differential diagnosis

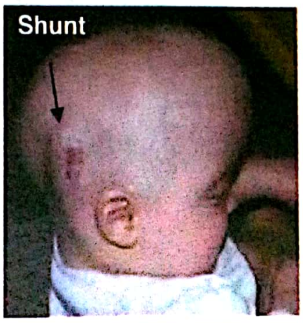
Causes of large head (see macrocephaly): Page 14

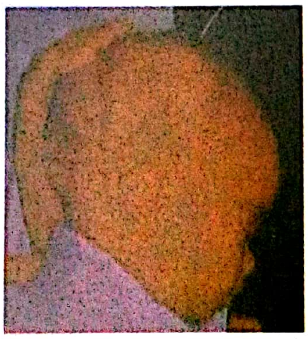
Treatment

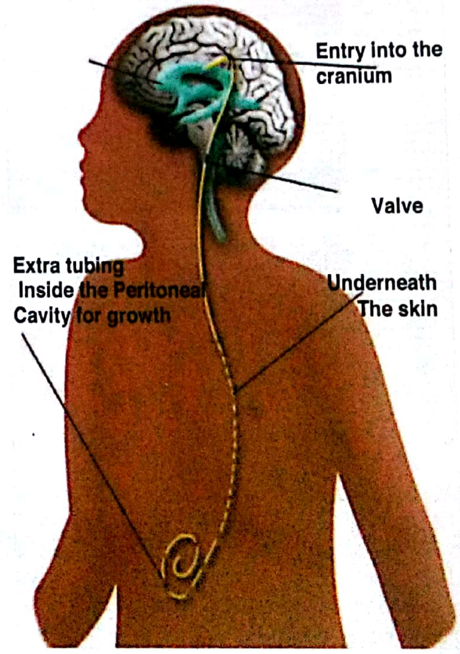
1. **Surgical**
    - ➢ Removal of cysts or tumors that cause obstruction
    - ➢ Non removable causes→shunt operation: ventriculoperitoneal shunt is the most common

    Shunt complications

    - Infection (septicemia and meningitis)
    - Obstruction, kinking or separation.
    - Shortening of the tube with time?







2. **Medical** not successful alone
    - Acetazolamide: 40 -75 mg/ kg/ 24 hours.
    - It Diminishes CSF production, may be effective in mild and slowly progressive hydrocephalus.

Cerebral Palsy

Definition

Non progressive , non-curable, non-fetal MOTOR disorder of posture and movement often associated with epilepsy and abnormalities of speech, vision, and learning problems due to an insult affecting the developing brain (before full maturation of CNS).

Etiology

Prenatal causes

1. Cerebral malformations
2. Congenital infections (TORCH infections)
3. Severe intrauterine fetal anoxia.

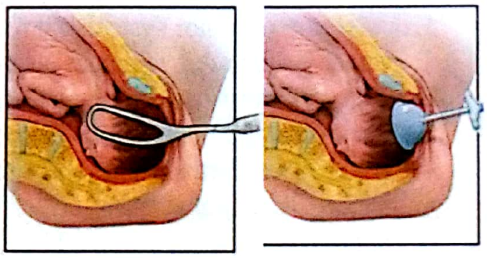
Perinatal causes

1. Hypoxic ischemic injury.
2. Intracranial Hemorrhage.

○ Prematurity is not a cause but frequently associated with asphyxia and intracranial hemorrhage.

Post- natal causes

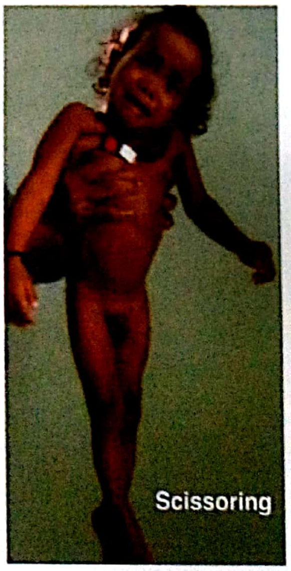
1. CNS infections: meningitis and encephalitis.
2. Severe Hypoxia: asphyxia and status epilpticus
3. Intracranial Hemorrhage.
4. Metabolic: hypernatremia and hypoglycemia
5. Kernicterus

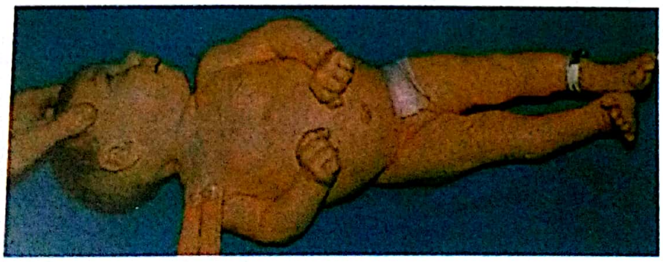


Clinical diagnosis

Early features of cerebral palsy

1. **M**otor delay
2. **M**icrocephaly (or slowing of head growth).
3. **M**oro reflex and other primitive reflexes persistence.
4. **A**bnormal limb or trunk posture
5. **A**symmetric hand functions.
6. **F**eeding difficulties: slow feeding and gagging.
7. **F**loppy infant at birth or early infancy.





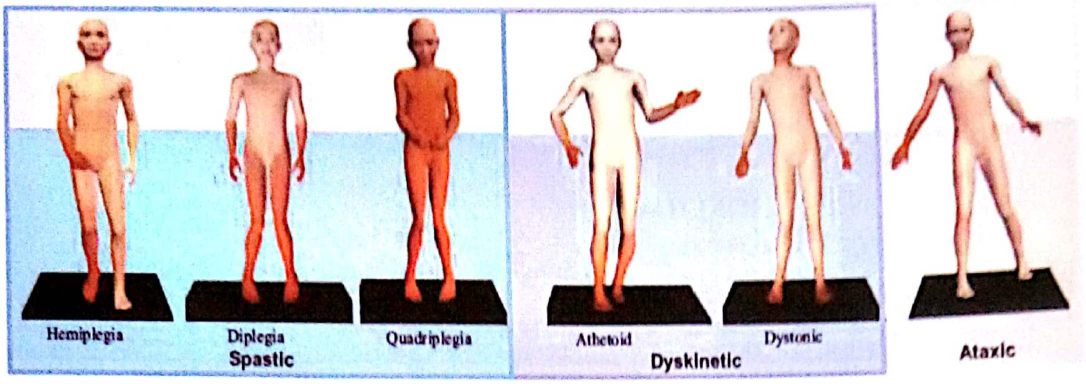
Diagnosis should include the following

1. **Etiology** of cerebral palsy. e.g. post hypoxic cerebral palsy.
2. **Type** of cerebral palsy e.g. spastic, dyskinetic, ataxic, mixed and cerebral hypotonia.
3. **Associated findings** e.g. motor (wasting), cranial nerves (bulbar) and microcephaly.
4. **Associated deficits** e.g. mental retardation, epilepsy and deafness.
5. **Degree** of functional disability

Differential diagnosis

1. Other causes of floppy infant (see later)
2. Other causes of spasticity as degenerative brain diseases
3. Other causes of ataxia

4 clinical Types of cerebral palsy: Spastic, Dyskinetic, Ataxic and Atonic

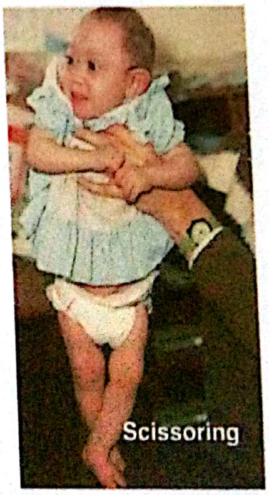


Spastic cerebral palsy: 70% of cases

- It is due to damage of cerebral motor cortex or its connections
- Examination of motor system and reflexes reveals:-
  1. State: wasting due to disuse atrophy.
  2. Power: paresis (quardriplegia, hemiplegia or diplegia).
  3. Tone: spasticity: clasp knife affecting antigravity muscles.
  4. In the upper limbs: biceps, pronators → flexed arm and forearm with fisting of the hands In the lower limbs: adductors and hamstrings → (extension and scissoring), calf muscles→ ankle clonus.
  5. Reflexes: deep reflexes are exaggerated and planter reflex is positive.

According to the power (degree of motor area damage) spastic CP is classified into 3 types

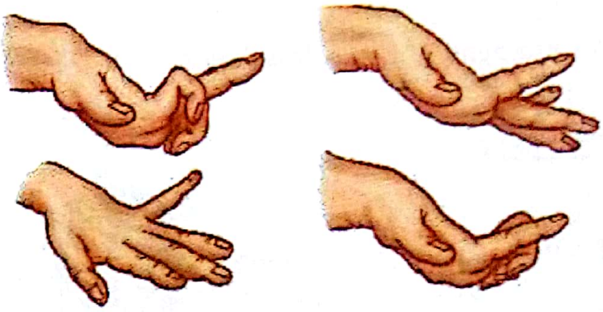
1. **Quadriplegic**
   - Paresis affects both sides of the body (upper limbs and lower limbs).
   - The arms are affected equal to or more than the legs.
   - There may have been a It is often associated with seizures, microcephaly, pseudobulubar affection and moderate or severe intellectual impairment.
   - History of hypoxic-ischemic encephalopathy at birth is usually present.



2. **Hemiplegic**
   - Paresis affects one side of the body.
   - The arm is usually affected more than the leg
   - Fisting of the affected hand and spared face
3. **Diplegic**
   - Paresis affects both lower limbs with arms are less affected or not affected

Dyskinetic (dystonic or athetoid) cerebral palsy: 10% of cases

- It is due to damage to the basal ganglia or their associated pathways (extrapyramidal).
- Examination
  1. Irregular involuntary movements of some or all muscle groups:
     - Athetosis is the commonest associated abnormal movement; it is purposeless snake like distal movement.
     - Chorea and dystonia (simultaneous contraction agonist and antagonist muscles involving the trunk or proximal limbs) may also present.
  2. Hypotonia and poor trunk control
  3. Delayed motor development in infancy, with abnormal movements sometimes not appearing before 1 year of age.



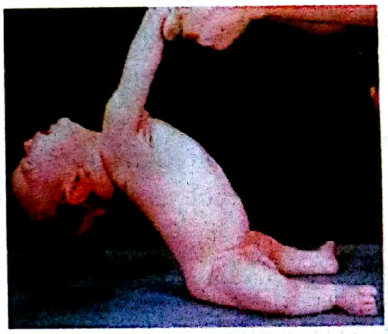
Athetosis

Ataxic cerebral palsy: 10% of cases.

1. It is due to damage in the cerebellum.
2. Presents with hypotonia, lack of coordination and intention tremors.

Atonic cerebral palsy (cerebral infantile hypotonia)

1. Floppy infant like picture, hypotonia of the trunk and neck muscles are severe.
2. Deep reflexes are preserved and even exaggerated.



Degree of functional disability

1. Class I: no limitation of activity
2. Class II: slight to moderate limitation
3. Class III: moderate to great limitation
4. Class IV: no useful physical activity

Investigations: see mental retardation P

1. **CT**
   - May determine the location and extent of structural lesion.
   - May show associated malformations or brain atrophy.
2. **EEG**

Treatment rehabilitation: see management mental retardation P:

1. Control of convulsions if present
2. Physiotherapy
3. Speech therapy
4. Drug therapy

Mental Retardation

Definition

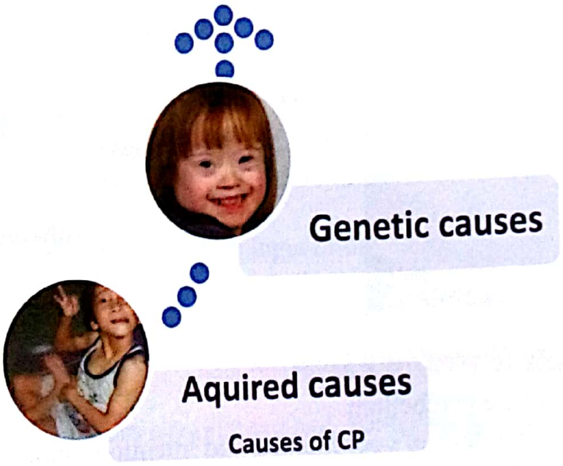
Intellectual impairment from early life and inadequate mental development throughout the growth period, manifested by impaired learning ability and poor social adjustment.

Grading

According to I.Q (intelligence quotient) = $\frac{\text{Mental age}}{\text{Chronological age}} \times 100$

		I.Q		
1.	Mild	between 75-50 %	Educable: represents 85 to 90% total
2.	Moderate	50-35%	Trainable
3.	Severe	35-20%	Non- trainable
4.	Profound	less than 20 %	Non- trainable

Etiology



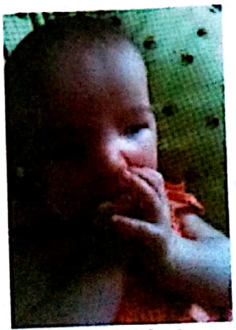
Genetic causes

Aquired causes

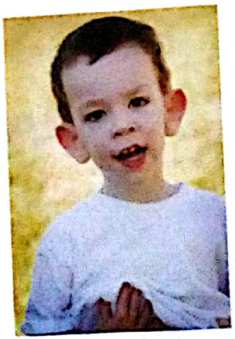
Causes of CP

Genetic causes

1. **Chromosomal abnormalities**
   - Trisomy: Down syndrome
   - Deletion: Cri du chat
   - Sex chromosome: fragile X syndrome.
2. **Neurometabolic disorders**
   - Carbohydrate: Galactosemia
   - Amino acids: phenylketonuria ,tyrosinemia
   - Organic acids: isovaleric acidemia

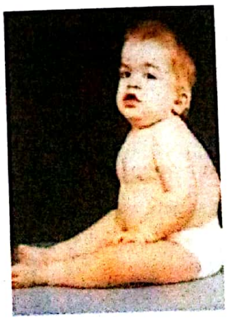


Cri due chat

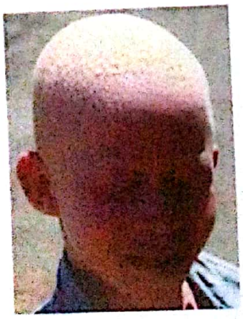


Fragile x

3. **Neurodegenerative brain disorders**
   - Lipidosis
   - Mucopolysaccharidoses.
   - Mitochondrial disorders.
4. **Neurocutaneous disorders**
   - Tuberous sclerosis.



Mucopolysaccharidosis



Phenylketonuria

Acquired causes: revise causes of cerebral palsy P 225

1. **Prenatal (intrauterine)**
   - Cerebral malformations (hydranencephaly)- Cerebral dysgenesis
   - Congenital infectoions (Cytomegalovirus, Rubella, Toxoplasmosis)
   - Severe intrauterine fetal anoxia
2. **Perinatal**
   - Hypoxic ischemic injury.
   - Intracranial Hemorrhage.
   - Prematurity is not a cause but frequently associated with asphyxia and intracranial hemorrhage
3. **Postnatal**
   - CNS infections: meningitis and encephalitis.
   - Severe Hypoxia: asphyxia and status epilepticus
   - Intracranial Hemorrhage.
   - Metabolic : hypernatremia and hypoglycemia
   - Kernicterus
   - Lead poisoning

- × Congenital hypothyroidism and phenylketonuria should not be causes as they should be diagnosed by routine screening tests and treated before causing mental retardation.
- × Unknown cause in 25% of cases of mental retardation.

Clinical diagnosis

1. **Is it static or progressive mental retardation?**
   - Static
     History, examination and follow up do not show any evidence of progressive course in the intellectual and motor deterioration e.g. cerebral palsy.
   - Progressive
     The condition starts by loss of previously acquired intellectual and motor skills. (loss of speech, vision , motor function ,seizures etc.) neurological manifestations of the disease become evident gradually over certain period of time according to the severity of the disease e.g. neurodegenerative and neurometabolic disorders
2. **What is the cause of mental retardation**
   Clinical features of some disorders e.g. Down syndrome , fragile X syndrome

Investigations

Laboratory

1. Karyotyping if a chromosomal abnormality is suspected or if the child is dysmorphic
2. DNA analysis
3. Congenital infection screening for the mother and the child
4. Metabolic screening e.g. blood lactate –plasma amino acids – ammonia
5. Urine : amino acids – organic acids – mucopolysaccharides
6. Thyroid function tests.

Imaging

1. CT or MRI to determine the degree of structural abnormalities of the brain (brain atrophy , intracranial calcifications with toxoplasmosis and CMV)
2. EEG.
3. Skeletal survey.

Hearing and vision assessment: visual evoke potential – auditory evoked potential

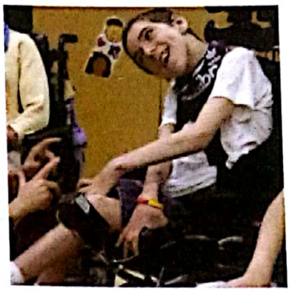
Management

General measures

1. Therapeutic program must begin as early as possible with the parents playing an active role together with the doctor and social workers.
2. Children with IQ ranging from 50-70 could achieve some independence ,while those with IQ below 50 are rarely independent and often need to be dressed and fed.

Specific measures

1. **Dietary measures**: in certain metabolic disorders of carbohydrate and amino acids e.g. Phenylalanine free formula in phenylketonuria.
2. **Physiotherapy and orthopedic measures to preserve muscle bulk and prevent deformities**
3. **Speech therapy** in case of hearing loss, and lack of coordination of tongue and palate.
4. **Ophthalmoscopic assessment**
    - Visual impairment may be due to optic atrophy or visual cortical damage
    - Squint may be due to external ocular muscles imbalance or paralysis.
5. **Drug therapy**→ antiepileptic drugs (epilepsy occurs in 30% of cases).



Microcephaly

Definition

Head circumference below 5th percentile for age and sex.

Etiology (revise causes of mental retardation- causes of cerebral palsy)

Primary (genetic)

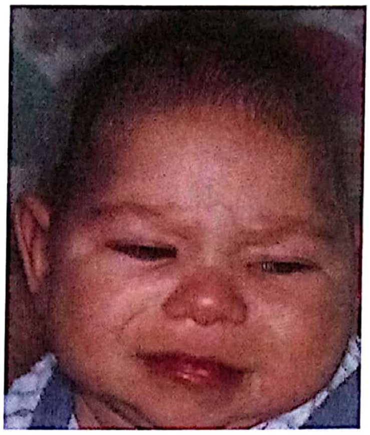
1. Familial (autosomal recessive)
2. Autosomal dominant
3. Syndromes (Down: trisomy 21) – (Edwards: trisomy 18)-(Cri du chat:5p⁻)

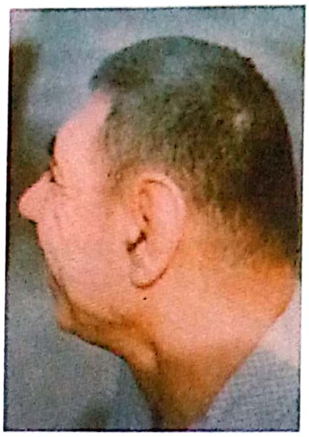
Secondary (non- genetic or acquired)

Destructive processes affecting the brain during fetal and early infantile life

1. **Prenatal causes**
    - Congenital infections e.g. cytomegalovirus, Rubella
    - Irradiation
    - Drugs e.g. → fetal alcohol syndrome, fetal hydantoin syndrome.
2. **Perinatal causes**
    - Hypoxic ischemic injury.
    - Intracranial hemorrhage.

3. **Post- natal causes**
   - Kernicterus
   - CNS infections: meningitis –encephalitis.
   - Intracranial hemorrhage.





Clinical evaluation

History

1. Prenatal e.g. history of drug intake or exposure to radiation
2. Natal e.g. obstructed delivery.
3. Postnatal e.g. meningitis.
4. Motor and mental development (mental retardation is common association)
5. Family history may be positive in familial cases.

Examination

1. Measure head circumference at birth, small circumference denotes intrauterine insult, serial measurement are more important.
2. Associated dysmorphic features and congenital anomalies
3. Detailed neurological examination

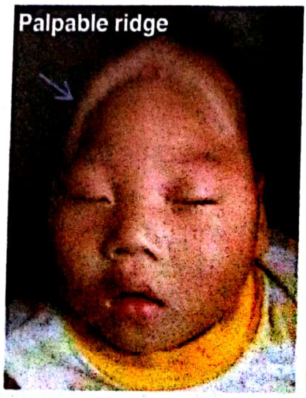
Investigations: investigations of mental retardation page 228

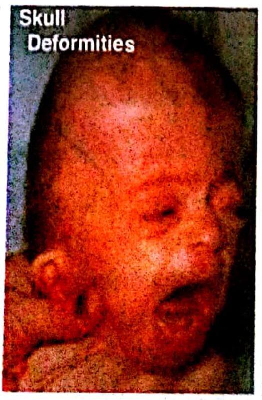
Differential diagnosis

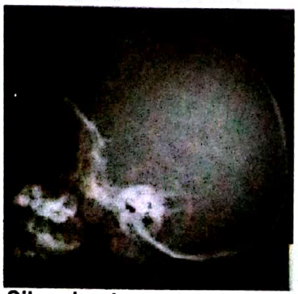
Microcephaly should be differentiated from craniostenosis which is premature closure of sutures and fontanels with decrease in the head size

In craniostenosis there is

1. Palpable ridge in the region of the prematurely closed suture.
2. Papilledema and other manifestations of increased intracranial tension
3. Skull deformities.
4. Skull X-ray: silver-beaten appearance.







Silver beaten appearance

Seizures

Definition

Seizure is a paroxysmal disorder that results from an abnormal excessive neuronal activity and characterized by any of the following:-
Alteration of consciousness, Abnormal motor activity, behavior abnormalities, sensory or Autonomic dysfunction. It should be viewed as a symptom of underlying disease process.

Etiology

1. **Non epileptics**
2. **Epilepsy : diopathic , genetic, symptomatic**

Non-epileptic: non recurrent (occasional) convulsions

One or more convulsive fits usually with the acute neurologic insult and stop with improvement of the disease (do not recur after recovery).

1. Febrile convulsions
2. CNS infections: meningitis, encephalitis, brain abscess.
3. Intracranial hemorrhage (spontaneous or traumatic).
4. Acute cerebral edema: hypertensive encephalopathy or head trauma.
5. Cerebral vascular strokes: thrombosis, embolism.
6. Toxic: tetanus- post immunization (DPT) - Gastroenteritis (shigellosis, salmonellosis)
7. Anoxic: sudden severe asphyxia.
8. Metabolic: hypoglycemia, hypocalcemia (tetany) and hypomagnesemia.

Epilepsy: recurrent convulsions unrelated to fever or to acute cerebral insult

1. **Idiopathic** (or cryptogenic): 80% the etiology is not determined.
2. **Genetic**
3. **Symptomatic or organic** (revise causes of mental retardation)
   - **Hereditary causes**
     - Neurometabolic disorders e.g. aminoacidopathy.
     - Neurodegenerative brain disorders e.g. lipidosis
     - Neurocutaneous disorders: tuberous sclerosis-sturge weber disease, neurofibromatosis.
   - **Acquired causes: (causes of cerebral palsy and acquired microcephaly)**

     Prenatal: congenital infections (Cytomegalovirus, Rubella, Toxoplasmosis and herpes simples)

     Perinatal
     - During pregnancy: placental insufficiency e.g. due to pre-eclampsia
     - During labor: hypoxic ischemic injury- Intracranial hemorrhage.

     Postnatal
     - CNS infections: post meningetic and post-encephalitic.
     - Trauma (intracranial hemorrhage).
     - Metabolic disorders: hypoglycemia, hypocalcemia and hypomagnesemia.
     - Kernicterus.

Febrile Convulsion

Incidence

It is the most common seizure disorder during childhood, 2-5 % of all normal children.

Etiology

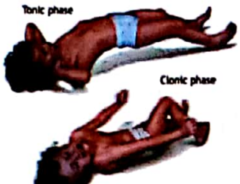
1. Genetic background
2. Acute extra-cranial infections e.g. tonsillitis, gastroenteritis, roseola infantum

Clinical picture

Simple febrile seizure: 80-85% of all febrile seizures

Patient type

1. Age : between 9 months and 5 years (peak onset 1-2 years of age)
2. Family history of febrile convulsions may be positive
3. Developmental history : normal
4. No clinical features of CNS infections e.g. repeated convulsions-neck rigidity.
5. Other causes of seizures are excluded e.g. head injury, intoxication
6. Evident extra cranial infection: e.g. otitis media, gastroenteritis or Roseola



Seizure type

- **Preictal** : fever
  1. The core temperature is 39 C° or more
  2. Convulsions occur at the onset of rise of temperature (few hours after the fever).
- **Ictal**
  1. Pattern: generalized tonic clonic
  2. Duration: short duration few seconds to few minutes (usually less than 15 minutes)
  3. Course: usually one convulsive fit during the same illness.
- **Postictal**
  1. Short postictal stupor (patient usually returns to normal alertness before arrival to hospital)
- **Simple febrile seizures don't cause brain damage, and no risk of developing epilepsy**

Complex febrile seizures: 15-20%

1. Last more than 15 minutes
2. Can recur within 24 hours
3. Have an increased risk of developing epilepsy.

Treatment

1. **Immediate first aid measures**
   - Patent Airway
   - Anticonvulsant drugs (IV or rectal Diazepam: 0.5 mg/kg)
2. **Measures to lower the temperature**
   - Tab water fomentations
   - Antipyretics e.g. Paracetamol : 10-15 mg/kg/dose
3. **Treatment of the cause** e.g. antibiotics for acute tonsillitis.
4. **Long term anticonvulsants** are controversial may be given in complex febrile seizures

Epilepsy

Incidence: 1 in 200 children

Types of epileptic seizures

Partial seizure

1. Simple partial
2. Complex partial

Generalized seizures

1. Absence
2. Generalized tonic clonic
3. Tonic seizures
4. Myoclonic
5. Atonic

Partial seizures

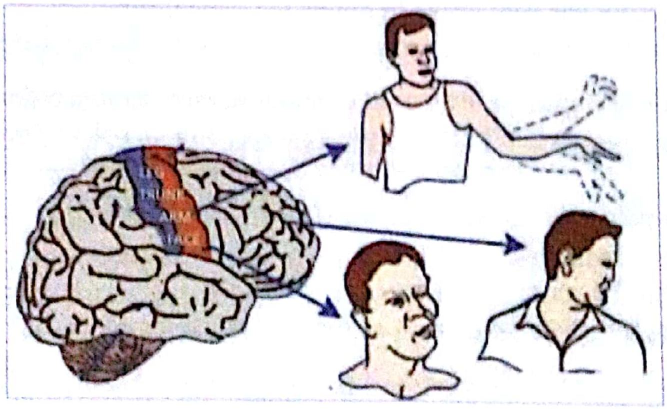
Generalized seizures

Partial (focal) seizures

Manifestations of focal seizures depend on the part of the brain where the discharge originates

1. Simple partial (frontal seizures that involve the motor cortex are the commonest)

- **Pre-ictal:** Aura may be present e.g. headache
- **Ictal**
  1. Twitching or jerking of one side of the body, one arm or one leg (partial).
  2. Consciousness is usually retained.
  3. May proceed to a generalized tonic clonic seizure (secondary generalization).
- **Postictal**
  - Weakness of the involved side (Todd paralysis).



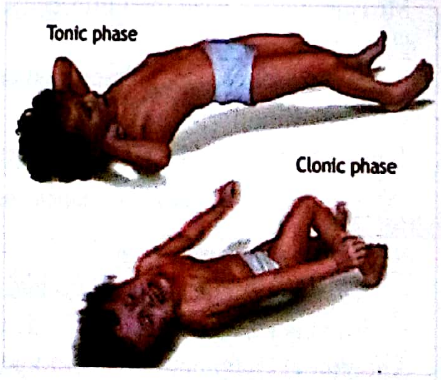
2. Complex partial (epileptic discharge in the temporal lobe): the commonest of all epilepsies

- **Preictal:** Aura may be present.
- **Ictal** (few minutes)
  1. Impaired consciousness:-usually without falling.
  2. Complex semi purposeful movements develop following the loss of consciousness.
  3. Diagnosis depends on carful description of the attacks and EEG
- **Post-ictal:** amnesia for the attack

Generalized seizures

1. **Absence**
   - **Preictal**: no aura
   - **Ictal**:
     - There is cessation of motor activity or speech with blank facial expression for 5 to20 seconds then continuation of the original activity as if nothing happened.
     - The attack can be triggered by hyperventilation for a minute.
   - **Postictal**: no postictal manifestations
   - × This form of epilepsy is usually idiopathic or genetic and has good prognosis.
   - × **EEG** is diagnostic.

2. **Generalized tonic clonic**
   - **Preictal**: aura e.g. headache
   - **Ictal**
     - Sudden loss of consciousness and falling.
     - Tonic phase
       With loss of consciousness, limbs are extended, eyes are rolled up and the head is thrown backward or to one side. Cyanosis of the face, biting the tongue, urination or defecation may occur during this phase.
     - Clonic phase
       It starts within minutes, with repetitive contraction and relaxation of all muscles. If it exceeds 30 minutes, the term status epilepticus is given
   - **Postictal**: deep sleep for hours



3. **Myoclonic**
   - Repetitive seizures consisting of sudden brief often symmetrical muscular contraction (flexion or extension) and falling with tendency to cause injuries to the face or the back of his head.

4. **Infantile spasm: serious type of myoclonic epilepsy**
   - Infants only: 3-8 months of age.
   - Brief symmetric contractions usually flexion of the neck, trunk and extremities occurring in clusters lasting for 15-30 minutes, several times per day.
   - 50% of cases have underlying neurological disorder
   - Resistant to antiepileptic therapy but it responds to corticosteroids or vigabatrin.
   - EEG is diagnostic: hypsarrythmia

5. **Atonic**
   - These attacks start suddenly by a synchronous increase in muscle tone or brief myoclonic jerking followed immediately by loss of postural tone and falling to the ground.

Clinical evaluation of a case of convulsions

History

1. Did the child have a seizure before?
2. Character of Seizures: type and distribution (partial or generalized), duration and frequency
3. Etiology of seizures:-
   - Manifestations of CNS infection (fever, vomiting, loss of consciousness)
   - History of trauma
   - Intellectual deterioration→ degenerative brain disorders
   - Vomiting, failure to thrive→ inborn errors of metabolism
4. Treatment history (prior anticonvulsant medication and the child's response)

Examination (directed to search for organic cause)

General

1. Vital signs: blood pressure (hypertensive encephalopathy) temperature(fever in infections or febrile convulsions)
2. Measurements: head circumference: microcephaly with congenital infections
3. Head and neck:-
   - Signs of increased intracranial tension (large head, bulging fontanel).
   - Neck rigidity→ meningitis
4. Trunk and limbs: skin lesions in neurocutaneous syndromes e.g. café au lait patches.

Systems

1. Neurological examination
   - Motor, Reflexes, sensations and cranial nerves examination.
   - Fundus examination : papilledema with increased intracranial tension.
2. Abdominal examination: organomegaly may suggest metabolic or storage disorders.

Investigations of seizures

Laboratory

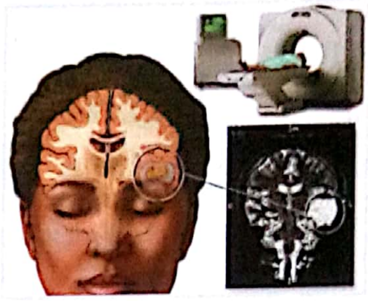
1. Blood picture.
2. Blood chemistry: Na - K – Ca, urea, creatinine and glucose.
3. CSF analysis if CNS infection is suspected.
4. Screening for inborn errors of metabolism
5. TORCH screening, if clinically indicated (microcephaly, recurrent seizures, cataract),

Imaging

1. **EEG**

   It is done during normal or induced sleep or with activation procedures as hyperventilation or photic stimulation.24-hour ambulatory EEG done in some cases.

2. **CT and MRI** if intra-cranial lesion is suspected (increased tension or focal deficit)



Treatment

Rules in long term antiepileptic therapy

1. Choice of drugs according to clinical and EEG findings.
2. Number of drugs: start with one drug (monotherapy) in small dose (to avoid toxicity, improve compliance and reduce the coast). A second drug is added (polytherapy) if the first drug failed to control seizures.
3. Dose: start with an average dose and gradual increase till seizure control.
4. Duration of therapy: at least 2 years after the child being seizure free
5. Termination of therapy: very gradual (status epilepticus develops with sudden termination)

Parent counseling

1. Avoid watching TV except in lighted room and far enough from the screen.
2. Computer games and swimming should be done under supervision.

Antiepileptic drugs

Drug	Seizure type	Dose (mg/kg/day)
1. Sodium valproate	- Generalized seizures: Tonic clonic, Absence and myoclonic - Partial seizures	10-40
2. Carbamazepine	- Partial seizures: the best in partial seizures - Generalized tonic clonic	10-30
3. Phenobarbitone	- Generalized tonic clonic and partial seizures	3-5
4. Phenytoin	as phenobarbitone	5-8
5. Clonazepam	- Myoclonic and Infantile spasms	0.05-0.1
6. Ethosuximide	-Absence and Myoclonic	20-40
7. Vigabatrin	- Partial and Infantile spasms	40-80
8. Lamotrigine	-Atypical absence seizures	5-10
9. Topiramate	- Partial seizures	5-10
10. Levetiracetam	- Partial, generalized or myoclonic seizures	15-50
11. Corticosteroids and ACTH	- Infantile spasms, myoclonic seizures - Symptomatic intractable seizures	

Status Epilepticus

Definition

Status epilepticus is a seizure lasting more than 30 minutes or when repetitive e seizures occur without reigning consciousness between them.

Etiology

1. Status epilepticus in the epileptic patient
2. Acute brain insult
    - CNS infections
    - Intracranial hemorrhage
    - Hypoxic encephalopathy
    - Metabolic encephalopathy
3. Prolonged (complex or atypical febrile) convulsions

Complications

1. Respiratory: apnea, airway obstruction, pulmonary edema, aspiration pneumonia
2. Neurological: cerebral ischemia, edema, hemorrhage and damage
3. Cardiovascular: shock, heart failure, hypertension and cardiac arrest
4. Metabolic: hyperpyrexia, metabolic acidosis, hypoglycemia, hyponatremia

Treatment of the ongoing seizures or treatment of status epilepticus.

First aid measures: ABC

1. A: open the airway
2. B: Breathing support and oxygen therapy
3. C: insert IV line and start infusion of ringer lactate or saline

Immediate anticonvulsant drugs to stop convulsions

1. Diazepam 0.5 mg/kg slow IV or rectal , if not controlled within 10 minutes, give
2. Phenobarbitone 15 -20 mg/kg slow IV (loading dose)
   5 mg/kg/d (maintenance dose) after seizure control

   If phenobarbitone failed to control the seizures within 10 minutes, shift to
3. Phenytoin: 15-20 mg/kg slow IV (loading dose)- 5mg/kg/day(maintenance) after seizure control
4. If not controlled, transfer to ICU
    - Diazepam or midazolam constant infusion.
    - Second line anticonvulsants (paraldehyde, lidocaine, thiopental)
    - Mechanical ventilation to insure adequate oxygenation and ventilation.

Meningitis

Definition

Inflammation of the meninges covering C.N.S (pia and arachnoid)

Viral infections are the most common cause of meningitis, and most are self-resolving

Bacterial meningitis have high incidence of acute complications and chronic morbidity

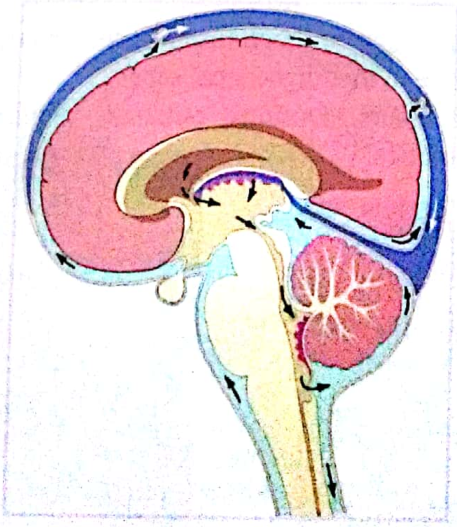
Etiology

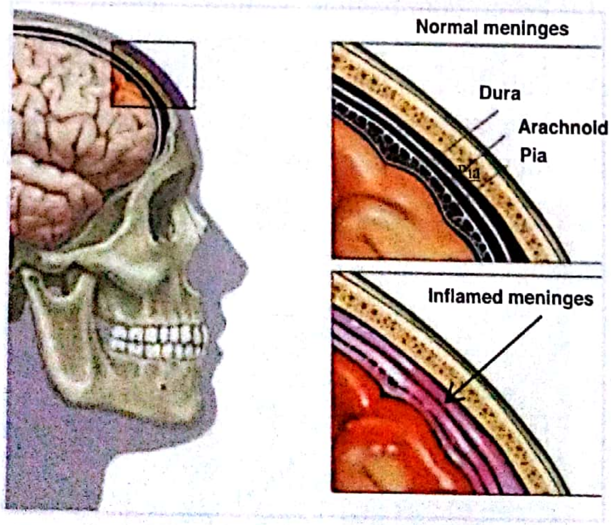
- **Organisms**
  1. **During the first 2 months of life**
     - B beta hemolytic streptococci
     - Gram negative enteric bacilli : E coli
     - Listeria monocytogenes
     - Less commonly haemophilus influenza
  2. **From 2 month to 12 years**
     - Hemophilus influenza type B
     - Pneumococci
     - Meningococci

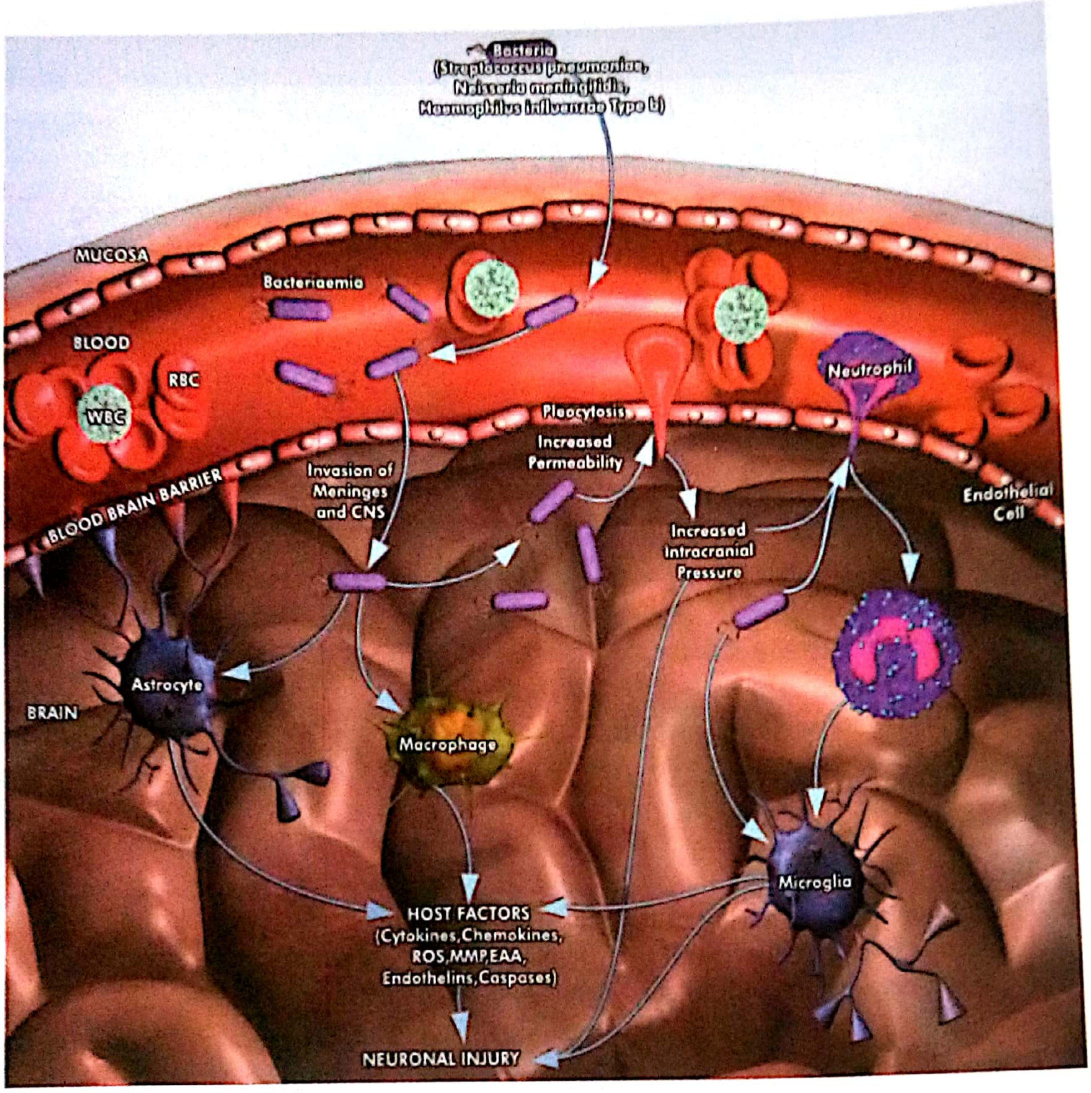
- **Mode of transmission**
  1. Droplet infection: during epidemics
  2. Blood spread: from a distant site
  3. Direct spread from otitis media or mastoiditis or orbital cellulites.

Pathophysiology

- Bacterial colonization of the nasopharynx is the usual initial site of infection.
- Bacteria enter CSF through the choroid plexus and meninges, then circulate into the extra cerebral CSF and subarachnoid space and rapidly multiply.
- Leucocytes infiltration and activation→ release of inflammatory mediators → endothelial damage→ cerebral edema, raised intracranial pressure.
- Inflammation of the spinal nerve roots produces meningeal signs







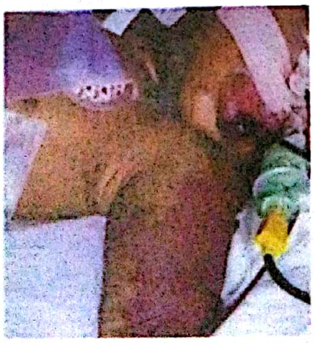
Diagnosis

Diagnosis depends on the presence of suggestive clinical manifestations that should be confirmed by CSF examination.

Systemic manifestations

1. Fever, poor feeding, vomiting, lethargy
2. Purpura, disseminated intravascular coagulopathy and may be shock (meningococcemia)

- Purpura in a febrile child should be assumed to be due to meningococcal sepsis.
- Meningococcal septicemia can kill children in hours. Optimal outcome requires immediate recognition, rapid resuscitation and antibiotics.



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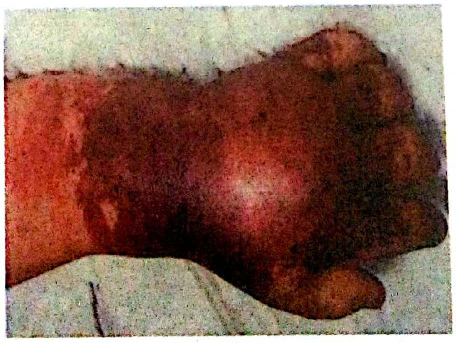

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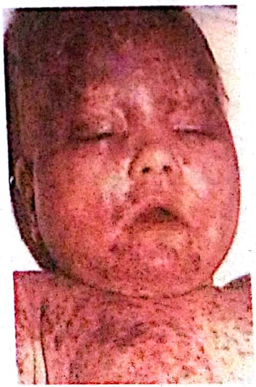
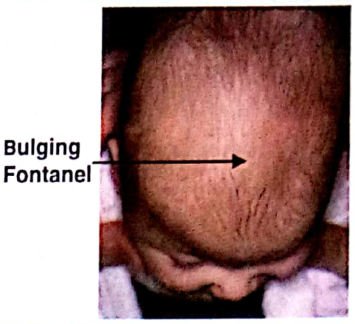


Purpura

Manifestations of increased intra-cranial tension



In infants

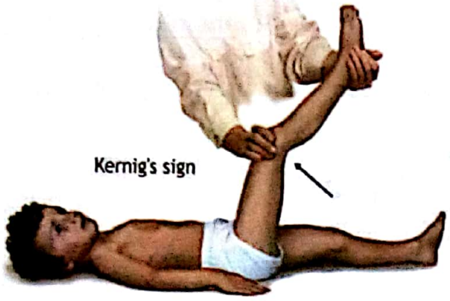
1. Bulging fontanelle and separated sutures: late signs.

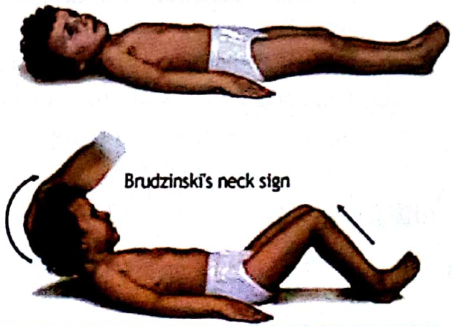
In older children

1. Projectile vomiting.
2. Severe headache.
3. Blurring of vision (papilledema): late sign.
4. Abducent or Oculomotor nerve paralysis.
5. Hypertension with bradycardia

Manifestations of meningeal irritation: absent in infants less than 18 months)

1. **Neck rigidity**: passive flexion of the neck is difficult and painful.
2. **kernig sign:** if the hip and knee joint are flexed at 90, extension of the knee will be limited.
3. **Brudzinski sign:** if the neck is flexed→ the hips and knees will be flexed too.





Manifestations of neurological deficits

1. Disturbed Conscious level: drowsiness, reduced consciousness or even coma.
2. Convulsions.
3. Focal paralysis

Investigations

CSF examination

1. Differentiating bacterial meningitis from tuberculous and viral meningitis : table below
2. Culture and sensitivity tests are essential: negative with (aseptic meningitis e.g. Viral)
3. Detection of antigens (PCR) and antibodies (ELIZA) of viral infection to exclude viral meningitis
4. Ziehl-Nielsen staining of the CSF if TB meningitis is suspected (may show acid-fast bacilli)

	Normal	Bacterial	Tuberculous	VIRAL
Aspect	Clear	Turbid	Opalescent	Clear
Chemical				
Protein: mg/dl	20-40	↑	marked ↑	Normal or mild ↑
Glucose: mg/dl	40-80 60% of blood glucose	↓	very low ↓	Normal
Chloride: mg/dl	720-750	↓	↓	↓
Cells	Lymphocytes 0-5/ mm^3	↑↑↑ Polymorph. 10-100,000	↑ lymphocytes 250-500	↑ lymphocytes 15-2000

Other investigations

1. CBC: marked leukocytosis with bandemia
2. Blood glucose and Blood culture
3. Kidney function test and electrolytes
4. Coagulation screen if DIC is suspected
5. If TB is suspected: chest X ray, tuberculin rest.
6. Consider CT, MRI and EEG.

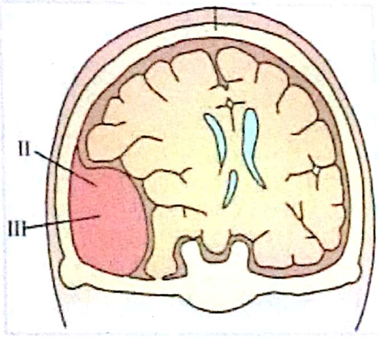
Contraindications of lumbar puncture

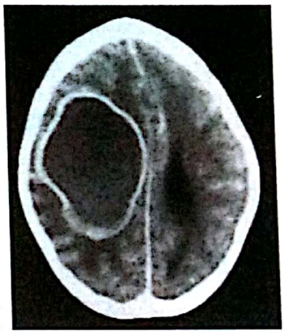
1. Cardiopulmonary instability
2. Coagulopathy or thrombocytopenia
3. Coma with conization signs
4. Infections at the site of lumbar puncture.

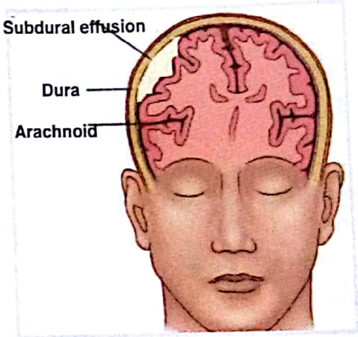
Complications

Early complications (occur during the course of illness)

- **C.N.S**
  1. Subdural effusion: enlarged head circumference and bulging fontanel. It is confirmed by CT.
  2. Convulsions focal or generalized.
  3. Cerebral abscess: there is deterioration of clinical condition with the appearance of signs of a space-occupying lesion. It is confirmed by CT scan.



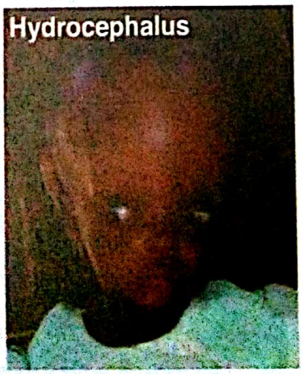


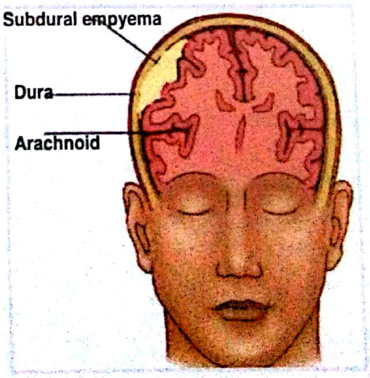


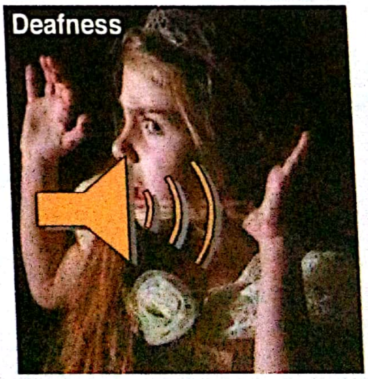
- **Vascular**
  1. Disseminated intravascular coagulopathy.
  2. Shock due to acute adrenal insufficiency.
  3. Inappropriate antidiuretic hormone release resulting in hyponatremia.

Late complications (occur after recovery and require follow up): CNS complications

1. Hydrocephalus due to inflammatory obstruction of CSF pathways.
2. Subdural empyema with development of increased intracranial tension.
3. Epilepsy due to focal infarctions and adhesions with underlying cortical irritation.
4. Mental retardation, cerebral palsy and learning deficits.
5. Deafness: damage of the 8th cranial nerve and cochlear hair cells.







Treatment

1. **Prevention**
   - **Vaccination**
     - Infants in the first year of life: HIB vaccine (against Hemophilus influenza) and pneumococcal conjugate vaccines.
     - Children:-Meningococcal polysaccharide vaccine at 2-3 years of age.
   - **Chemoprophylaxis**
     - Rifampicin used to eradicate meningococci from the nasopharynx of carriers.
2. **Supportive treatment**
   1. **I.V fluid** if meningitis is complicated by shock (otherwise **fluid is restricted to** minimize cerebral edema: **only 75% of maintenance is given**).
   2. **Anticonvulsants**: diazepam and phenobarbitone.
   3. **Assisted ventilation** if respiratory failure occurs.
   4. **Subdural taps** to evacuate extensive subdural effusions
3. **Specific treatment**
   1. **Antibiotics: IV for at least 10- 14 days (in neonates 3 weeks)**.
      Initial antibiotics are based on the patent's age, and then modified according to the result of culture and sensitivity tests.
      - **Neonates and infants below 2 months:-**
        Third generation cephalosporins e.g. **Ceftriaxone** 200 mg kg/day plus ampicillin 100mg/kg/day.
      - **Infants and children above 2 months:-**
        Third generation cephalosporin e.g. **Ceftriaxone** 200mg/kg/day.
   2. **Dexamethasone** (for 2days) with H influenza to decrease incidence of hearing loss
4. **Follow up** to detect late complications e.g. Epilepsy and mental retardation
   By periodic monitoring of neurological and developmental status for at least 2 years

TB meningitis

Etiology: TB bacilli secondary to hematogenous spread or miliary TB.

Clinical picture: The onset of the illness is often insidious, over 2-3 weeks
TB meningitis should be considered in any case of aseptic meningitis or encephalitis.

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Treatment: anti TB drugs should be started when diagnosis is suspected. P: 76

Viral meningitis: 2/3 of cases of meningitis

Etiology

1. Enteroviruses (e.g. echo virus, Coxsackie) are the commonest.
2. Epstein-Barr virus, adenoviruses and mumps.

Clinical picture

1. More abrupt but milder than acute purulent meningitis.
2. Consciousness is usually not affected and most cases full recovery occur.

Investigations: Page 241

Encephalitis

Definition

Inflammation of the brain commonly due to viral infection (meninges are commonly affected also)

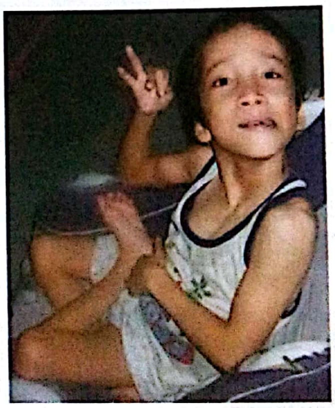
Etiology

1. Herpes simplex type 1 and type II : the commonest cause of sporadic cases
2. Enteroviruses (Echo and Coxsackie): Cause encephalitis outbreaks during summer
3. Epstein Barr virus.
4. Cytomegalovirus and HIV.
5. Viruses transmitted from animal to human : Arboviruses (arthropod-borne) - Rabies.
6. Viruses associated with childhood illness
   Measles, rubella, Chicken pox, and Mumps: cause acute or post infectious encephalitis, that is mediated by immune mechanisms.

Clinical picture

It is not possible to clinically differentiate encephalitis from meningitis, and treatment for both should be started once diagnosis is suspected.

1. Manifestations of Viremia: fever, nausea, and upper respiratory symptoms.
2. Manifestations of meningeal irritation but less severe than meningitis: enumerate
3. Manifestations of increased intracranial tension less severe than meningitis: enumerate
4. Manifestations due to focal neurological deficits
   - Disturbed level of Consciousness, irritability, abnormal movements, confusion up to deep coma
   - Convulsions
   - Paralysis or paresis and spasticity are common.
   - Encephalitis may present insidiously with behavioral change.
5. Manifestations of complications (post encephalitic sequelae) may develop later on:-
   - Epilepsy
   - Mental retardation, cerebral palsy and learning deficits
   - Auditory, visual, speech and behavior abnormalities.



Investigations

Laboratory

1. **CSF**: see meningitis discuss all items in the table. CSF should be examined directly for bacteria and cultured for bacteria, mycobacterium, fungi and viruses
2. **Serological tests**: to detect antiviral antibodies (complement fixation, hemagglutination inhibition test and ELISA test).

Imaging

1. **MRI**: helpful in postinfectious encephalitis (may show foci of demyelination). In herpes encephalitis there is temporal lobe demyelination.
2. **EEG**: generalized slowing of the background activity

Brain biopsy (rarely done): in deteriorating undiagnosed cases with no response to treatment.

Treatment

1. **Supportive: ICU management**
   - Control of convulsions (diazepam and phenobarbitone).
   - Measures to lower the increased intracranial tension.
   - Dehydrating measures to lower the increased intracranial tension.
     - Decrease fluid intake to 70% of daily requirement.
     - Dexamethasone and Diuretics.
     - Head elevation 30 ° in neutral position.
     - Mechanical hyperventilation in severe cases.
2. **Antiviral therapy:** possible only with Herpes simplex encephalitis: Acyclovir

   Herpes simplex virus may have destructive long-term consequences. All children with encephalitis should therefore be treated initially with Acyclovir to cover this possibility.

Brain abscess

Etiology

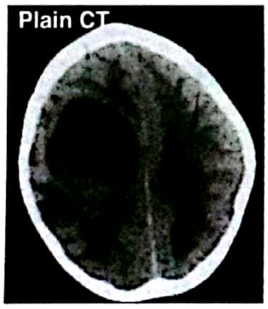
- **Organisms**: Staph aureus, streptococci and others.
- **Origin:**
  1. Direct spread from sinusitis, orbital cellulitis, chronic otitis media and mastoiditis.
  2. Direct spread from face, scalp, dental infection and penetrating head injuries.
  3. Congenital cyanotic heart disease, meningitis and infected ventriculoperitoneal shunts

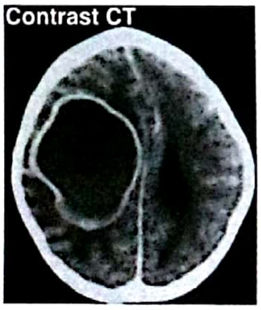
Pathology

- Sites: frontal, parietal and temporal lobes are the most commonly affected
- Number: single or multiple (multiple brain abscesses are common with meningitis and congenital heart diseases

Clinical picture

1. Manifestations of toxemia: fever
2. Manifestations of increased tension:-
   Headache, vomiting
3. Focal neurological signs:-
   Hemiparesis, convulsions and may be coma





Investigations: CT or MRI which is the most reliable

1. Plain CT→ rounded hypodense lesion.
2. Contrast CT→ the abscess capsule shows ring enhancement.

Treatment

Combination of antibiotics and drainage.

Neuromuscular disorders

Anterior horn cells

1. Werdnig Hoffmann disease: genetic disease presents with severe hypotonia (floppy infant).
2. Poliomyelitis: infectious disease presents with acute paralysis.

Peripheral nerves

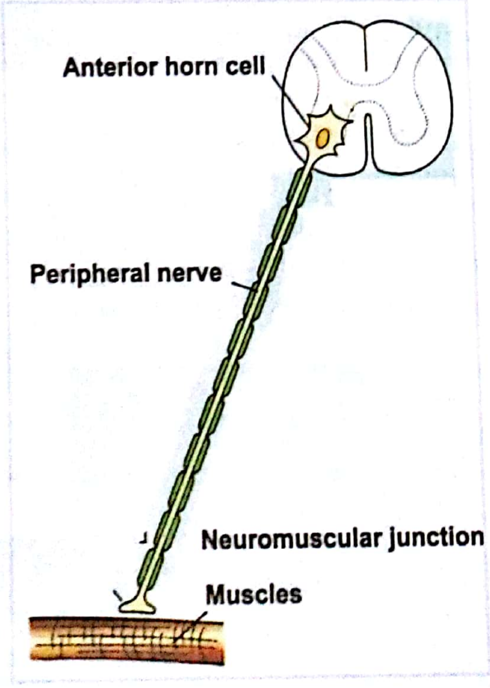
1. Hereditary motor sensory neuropathies.
2. Acute post infectious polyneuropathy (Guillain Barre syndrome).
3. Bell's palsy.

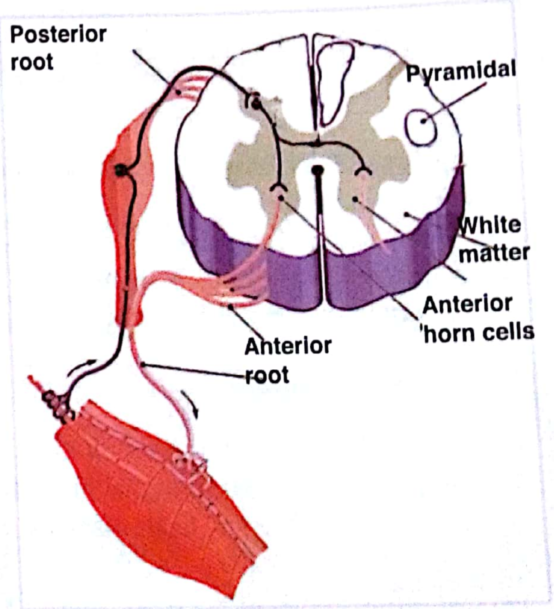
Neuro muscular junction

1. Myasthenia gravis: autoimmune disease, presents with motor weakness.
2. Botulism: presents with acute paralysis.

Muscles (myopathy)

1. Muscular dystrophies: Duchenne – Becker- congenital.
2. Inflammatory myopathies: dermatomyositis.
3. Metabolic myopathy.
4. Congenital myopathy.





Clinical presentations of neuromuscular disorders

1. Floppy infant: severe hypotonia at birth or early infancy.
2. Acute paralysis: acute loss of previously acquired motor skills.
3. Progressive motor weakness: gradual progressive loss of motor skills.
4. Delayed motor development: delayed head support, sitting and standing.
5. Fatigability (Myasthenia gravis).

Floppy Infant

Definition

Severe persistent hypotonia presenting at birth or in early infancy

Etiology

Central (cerebral) causes

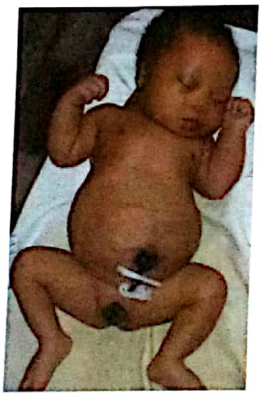
1. Atonic cerebral palsy.
2. Cortical malformations.

Genetic causes

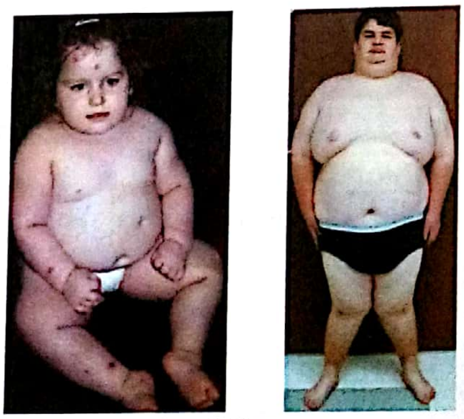
1. Down syndrome.
2. Prader-Willi syndrome

Peripheral: Neuromuscular disorders

1. Anterior horn cells: spinal muscle atrophy: Werdnig Hoffmann disease. The most common
2. Peripheral Nerves: hereditary neuropathy
3. Neuromuscular junction: transient neonatal myasthenia.
4. Muscle diseases: congenital myopathy



Down syndrome
Developmental delay - Hypotonia



Prader- Willi syndrome
Developmental delay - Hypotonia
Obesity

Clinical manifestations

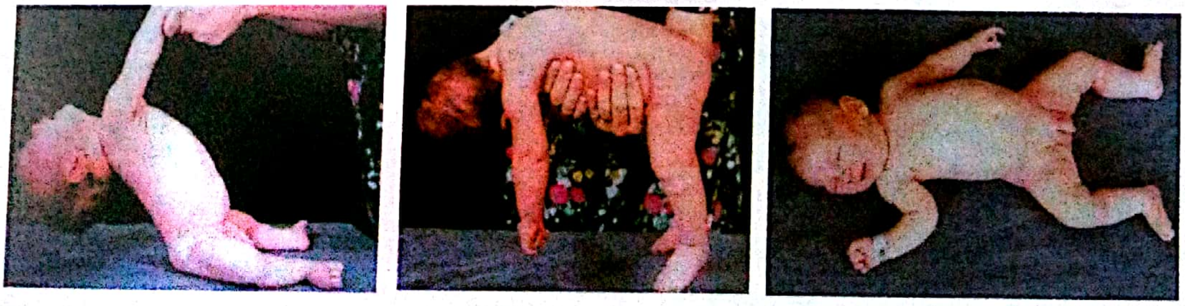
Manifestations of hypotonia

1. Hypotonia of neck muscles→ head lag.
2. Hypotonia of trunk muscles→ curved trunk on ventral suspension.
3. Hypotonia of limb muscles→ frog leg position (limbs are abducted and flexed).

Manifestations that differentiate central from neuromuscular causes

1. In central group: reflexes are normal or exaggerated.
2. In neuromuscular group: reflexes are week or absent

Manifestations that may suggest the cause: discuss shortly

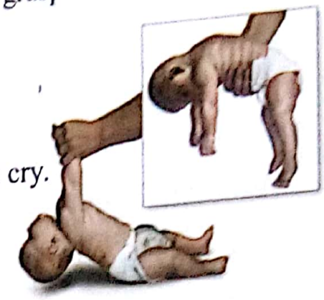


Spinal muscle atrophy type 1: Werdnig Hoffmann disease

Etiology

Genetic disease transmitted as autosomal recessive (gen in chromosome N 5)
There is progressive degeneration of the anterior horn cells that begins in fetal life and continues in infancy. Degeneration is due to failure to arrest apoptosis.

Clinical picture



Neonatal period:-the condition may present with: hypotonia, absent grasp reflex.

Later on

1. **Motor system**
   - State: muscle wasting, fasciculations (best seen in the tongue).
   - Power: severe weakness
     Weakness of the respiratory muscles→ weak cough and weak cry.
   - Tone: severe hypotonia→frog position and head lag
2. **Reflexes: absent**
3. **Normal mentality** and normal eye movement.
4. **Death** from aspiration pneumonia and respiratory failure by about 12 months.
5. **EMG** (electromyography) and muscle biopsy confirm the diagnosis.

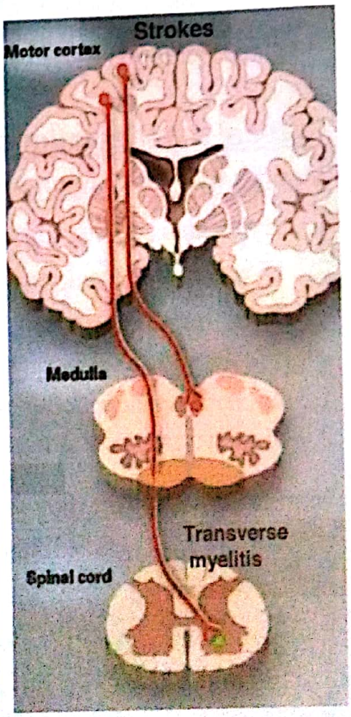
Acute Paralysis

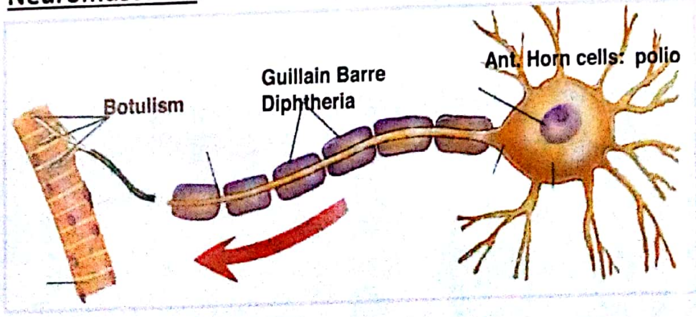
Definition

Rapid loss (within hours or days) of the previously acquired motor skills

Etiology

1. **Cerebral** strokes : infective endocarditis, sickle cell anemia
2. **Spinal cord**
   - Transverse myelitis
   - Spinal cord trauma
3. **Anterior horn cells**
   - Poliomyelitis: asymmetric *ascending* paralysis.
1. **Peripheral nerves**
   - Guillain Barre syndrome (the commonest cause)
     Symmetric ***ascending*** paralysis.
   - Post diphtheritic paralysis
     Symmetric ***descending***
     Pure motor paralysis that resolves within few weeks
5. **Neuromuscular:** Botulism: symmetric ***descending*** paralysis





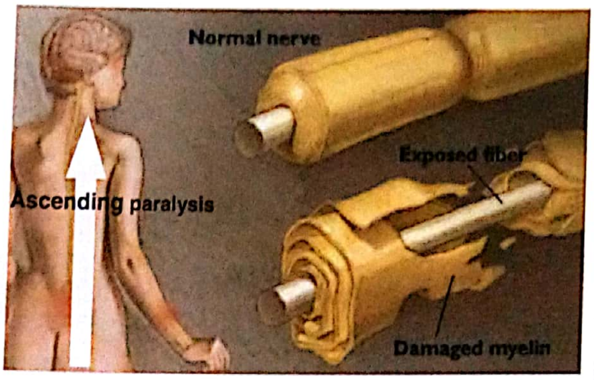
Acute post infectious polyneuropathy : Gillian Barré syndrome

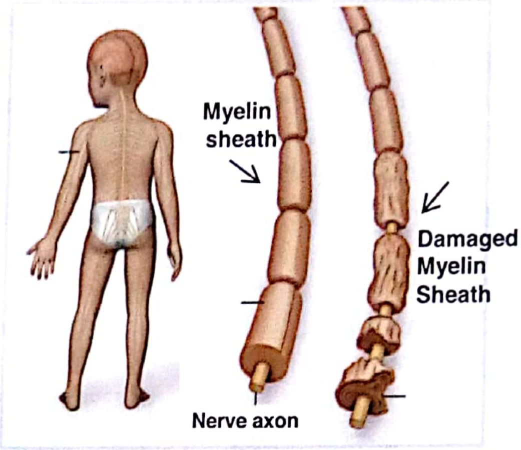
Incidence

It is the most common cause of acute paralysis in children

Etiology

- It follows bacterial infections e.g. Campylobacter jejuni or viral infections e.g. Cytomegalovirus
- Manifestations are due to post infectious demyelination.



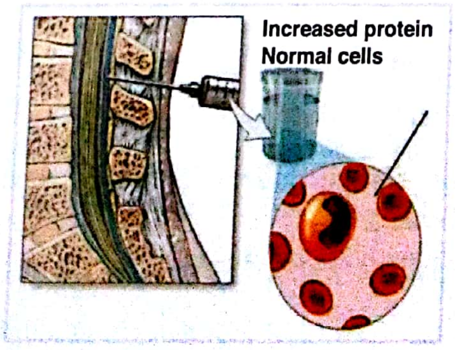


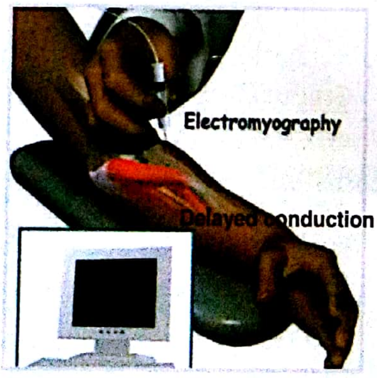
Clinical picture

- **History of preceding infection** respiratory infection or GIT infection few weeks before the onset of paralysis.
- **Neurological examination**
  1. **Motor**: acute paralysis which is:
     - Ascending
       - Begins in the lower limbs and progressively ascends within hours or days to involve the trunk and upper limbs.
       - Respiratory muscles affection leads to paradoxical breathing: seesaw abdominal movements → respiratory failure
     - Symmetrical
  2. **Reflexes**: hyporeflexia or areflexia.
  3. **Sensations**: paresthesia in some cases.
  4. **Cranial nerves**: Bulbar and facial paralysis may occur.
- **Gradual complete recovery over few or several weeks**, in some patients' paralysis may persist for several months.

Investigations

1. **CSF analysis** (2 weeks after the onset of paralysis)
   Cytoalbuminous dissociation (increased protein but with normal cell count).
2. **EMG**: Decreased nerve conduction velocity





Treatment

1. ICU and mechanical ventilation for cases with respiratory muscles paralysis (lifesaving).
2. IV gamma globulin in all patients for 5 successive days.
3. Plasmapharesis.
4. Physiotherapy should start from the second week of illness.

Poliomyelitis

Incidence

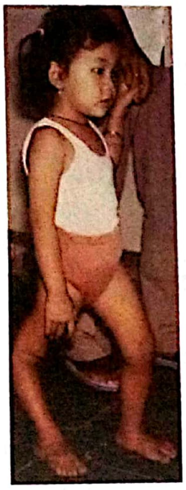
With compulsory vaccination it became a rare disease and is expected to be eradicated

Etiology

1. Acute viral infection of the anterior horn cells.
2. Transmission: is oral and droplet.
3. Man is the only reservoir.

Clinical types

1. Asymptomatic infection (90-95% of cases)
2. Abortive poliomyelitis
3. Non paralytic
4. Paralytic



This image represents the first recorded case of polio; showing wasting of the right limb muscles with down-flexed foot, typical of poliomyelitis. Carlsberg museum, Copenhagen

Diagnosis of paralytic poliomyelitis

- **Acute paralysis**
  - **Type**
    1. Lower motor neuron lesion (hypotonia , hyporeflexia).
    2. Pure motor no sensory affection as the site of destruction is the anterior horn cells or cranial nerve nuclei (polio = gray matter. myelitis =spinal cord inflammation).
  - **Distribution**
    1. Unilateral and if bilateral, it is asymmetrical. One limb is more affected
    2. In some patients, bulbar and respiratory paralysis may occur.
- **Gradual incomplete recovery** usually follows the paralysis.

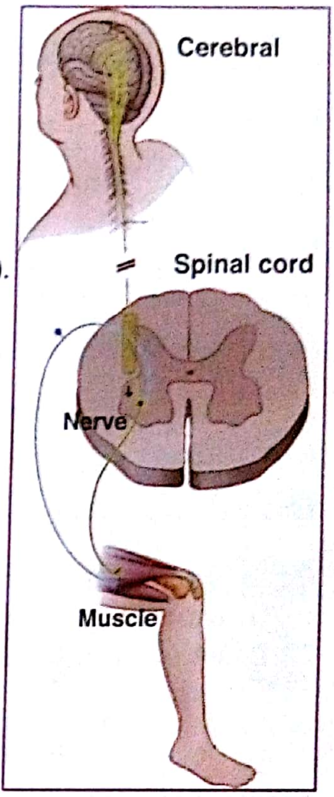
Treatment

1. Acute stage (first 2 weeks): isolation and treatment of bulbar and respiratory affection.
2. Restoration stage (2 weeks to 6 months): physiotherapy.
3. Residual stage (after 6 months): orthopedic correction of contractures.

Progressive Motor Weakness

Definition

Gradual loss of previously acquired motor skills. Progression may be rapid over weeks or months (tumors) or slow over months or years as in degenerative brain disease and muscular dystrophy.



Etiology

1. **Cerebral causes**
   - Brain tumors and cysts.
   - Degenerative brain diseases.
2. **Spinal cord causes**
   - Compression paraplegia (spinal cord tumors, Pott's disease).
   - Degenerative diseases of the spinal cord.
3. **Peripheral nerves**
   - Hereditary motor sensory neuropathy
4. **Muscular causes**
   - Muscular dystrophies (Duchenne muscular dystrophy).

Clinical evaluation

1. **Differentiate between upper and lower motor neuron lesions**
   - Upper motor neuron lesions: hypertonia and hyperreflexia
   - Lower motor neuron lesions: hypotonia and hyporeflexia
2. **Diagnosis of the cause**
   - Cerebral causes: increased intracranial tension, convulsions or mental affection are usually present.
   - Spinal cord lesions: lower limbs only are usually affected; other manifestations as urinary incontinence of urine are usually present.
   - In muscular dystrophy progression is very slow over years and in Duchenne type there is pseudohypertrophy of calf muscles is present.

Investigations

1. CT and MRI in suspected brain or spinal cord lesion
2. Serum CPK, electromyography and muscle biopsy with suspected muscular disease

Duchenne Muscular Dystrophy

Incidence

The most common and most serious muscular dystrophy

Etiology

X linked recessive disorder (mutation in Dystrophin gene in Xp21): males are only affected?

Pathogenesis

Dystrophin maintains the integrity of the muscle cell wall. Where it is deficient, there is an influx of calcium ions, a breakdown of the calcium calmo-dulin complex and an excess of free radicals. These lead to irreversible destruction of the muscle cells.

Clinical picture

History: rarely given before the age of 3 years

1. Difficulty in getting up stairs and in getting up from sitting position, of gradual onset and slowly progressive course up to difficulty in walking.
2. Family history may be positive from the mother side (it is transmitted from carrier mothers to their sons).

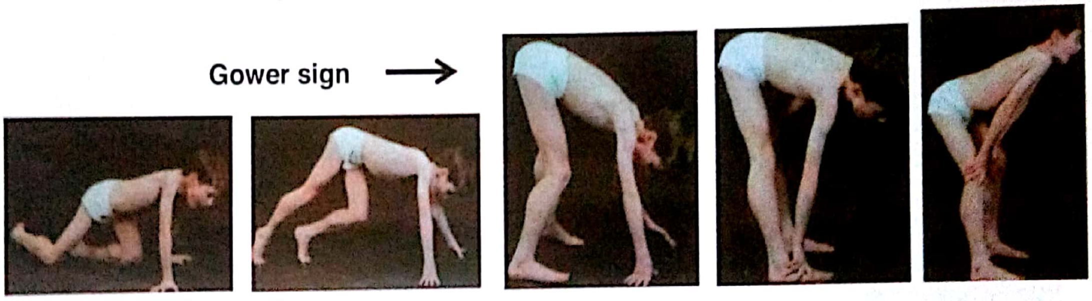
Examination

Neurological examination

1. **State**
   - Pseudo hypertrophy of calf muscles, early and constant sign followed by muscle of the forearm.
2. **Power and tone**
   - **Weakness and hypotonia of muscles of pelvic girdle** ➔ Waddling gait and positive Gower sign: characteristic manner in getting up from the ground (the child climbs his legs).
   - **Weakness and hypotonia of shoulder girdle muscles** ➔
     - Inability to comb the hair
     - Inability to raise the arm above the head
   - **Weakness and hypotonia of trunk muscles** ➔ **scoliosis and lumbar lordosis**
3. **Mild mental affection**

Other systems examination

1. **Heart**: cardiomyopathy→ cardiomegaly
2. **Death** occurs usually in the second decade (15-25 years) from respiratory and heart failure



Gower sign →

Investigations

1. Serum CPK (creatine kinase) .Marked elevation even at birth (can be used as screening test).
2. Electromyography
3. DNA studies: deletion on Dystrophin gene: antenatal diagnosis and carrier detection.
4. Muscle biopsy: diagnostic (absent Dystrophin).

Treatment

1. Nutritional support and physiotherapy.
2. Appropriate exercise to maintain muscle mobility and delays the onset of scoliosis.
3. Corticosteroids: (prednisolone for 10 days per month) to preserve mobility and prevent scoliosis (its action may be inhibition of muscle proteolysis, a stimulatory effect on myoblast proliferation, and increase in myogenic repair).

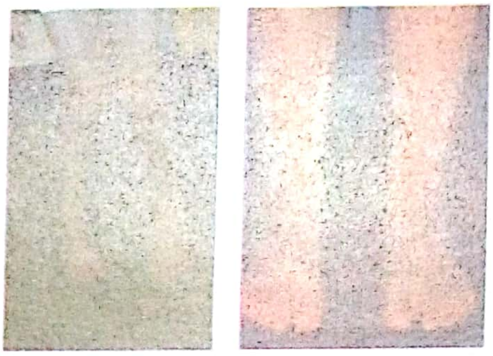
Differential diagnosis(other muscular dystrophies)

1. Beker dystrophy: delayed onset, slower course. Dystrophin is reduced in amount
2. Limb girdle dystrophy. Autosomal recessive (girls and boys are affected).
3. Metabolic myopathies e.g. glycogen storage disease.

Arthritis

Causes

1. **Infections**
   - Bacterial: septicemia (septic arthritis), TB arthritis
   - Viral: mumps, rubella, Adenovirus – Coxsackie B, herpes, hepatitis, parvovirus
   - Others: Mycoplasma
   - Reactive: Salmonella, Shigella, Campylobacter and streptococcal infection. The most common form of arthritis in childhood.
2. **Post-infectious: rheumatic fever**.
3. **Collagen vascular diseases**:
   - juvenile rheumatoid arthritis: JRA
   - Systemic lupus erythematosus
   - Dermatomyositis
   - Polyartritis nodosa
4. **Vasculitis**
   - Henoch-Schonlein purpura
   - Kawasaki disease
5. **Hematological**: sickle cell anemia, hemophilia and leukemia.
6. **GIT**: inflammatory bowel disease: Crohn's disease, ulcerative colitis.
7. **Other**: traumatic



Juvenile rheumatoid arthritis: juvenile idiopathic arthritis

It is clinical diagnosis based on the presence of persistent arthritis for more than 6 weeks after exclusion of other causes of arthritis

Polyarticular (5 joints or more)	**Pauciarticular: 4 joints or less**		**Systemic onset**
	Type 1	**Type 2**	
Joints . Symmetrical affection of **5 joints or more** . large and small joints . Limb joints, cervical spine, tempromandibular Joints	Asymmetrical arthritis usually knee and ankles	Swollen knee, ankles, etc.	Joint symptoms may be absent at the onset
Systemic manifestations . Mild anemia . Low-grade fever,	. High risk of developing chronic iridocyclitis which is usually asymptomatic	May progress to a juvenile ankylosing spondylitis	Fever: intermittent ,Rash, Anemia, Hepatosplenomegaly Pericardial effusion
Others Rheumatoid factor $^{-}$Ve (moderate prognosis) Rheumatoid factor $^{+}$Ve (poor prognosis)	Antinuclear antibodies may be positive	Old boys Family history of HLA b27 related disease	No specific laboratory marker

Complications

1. Flexion contractures of the joints.
2. Growth failure.
3. Amyloidosis.

Treatment

1. Non-steroidal anti-inflammatory drugs to control pain and suppress inflammation
2. Intravenous methylprednisolone.
3. Methotrexate by subcutaneous injection, but can also be given orally. Its early use reduce joint damage
4. Anti-TNF (anti-tumour necrosis factor) therapy and other biological agents

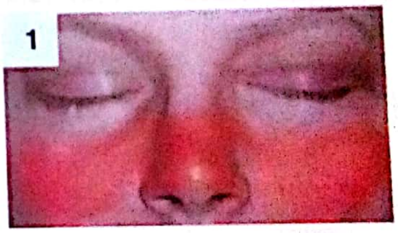
Juvenile systemic lupus erythematosus

- Autoimmune disease.
- Characterized by inflammation of the blood vessels and connective tissue.
- Extremely variable clinical manifestations and unpredictable natural history.

Diagnosis of systemic lupus erythematosus; 4 CRITERIA are

Mucocutaneous: 4

1. Malar rash.
2. Discoid lupus rash.
3. Photosensitivity: abnormal skin reaction on sun exposure.
5. Oral or mucocutaneous ulceration.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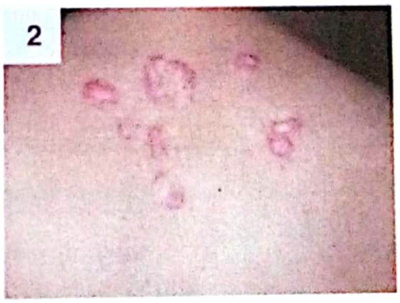
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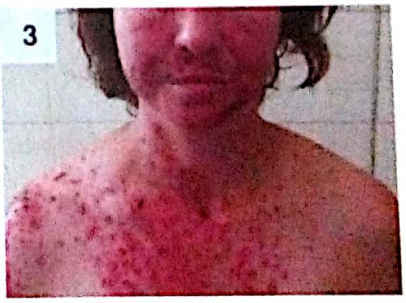
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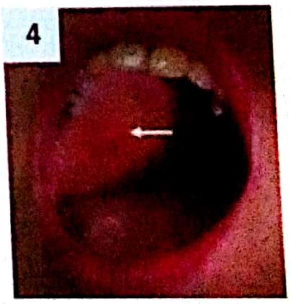
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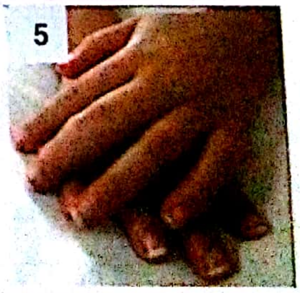
Systems: 4

1. Non erosive arthritis: usually small joints.
2. Nephritis (proteinuria > 0.5 gm/dl-cellular cast).
3. Pleuritis or pericarditis.
4. Encephalopathy(seizures –psychosis).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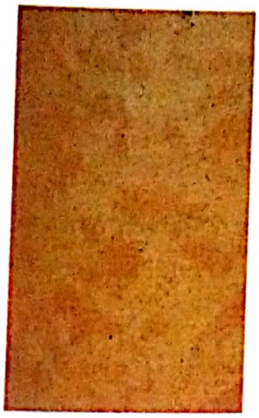
Investigations: 3

1. Cytopenia.
2. Positive antinuclear antibody test.
3. Positive immunoserology: antibodies to double strand DNA

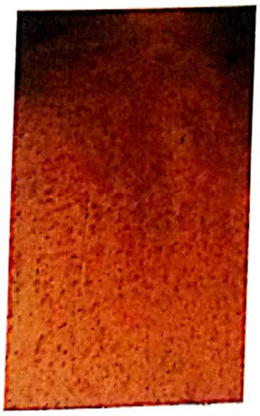
Rashes



Macules

. Pink flat areas

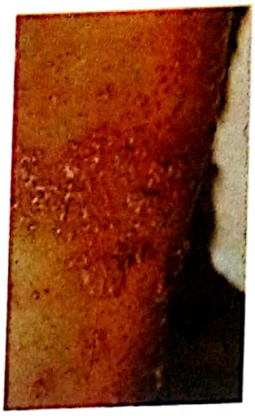
. Blanch on pressure



Papules

. Solid raised lesions

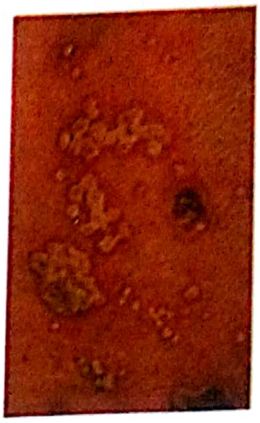
. Blanch on pressure



Vesicles

. Raised lesions

. Containing fluids



Pustules

. Raised lesions

. Containing pus

Causes (differential diagnosis) of maculopapular rash

1. Infections

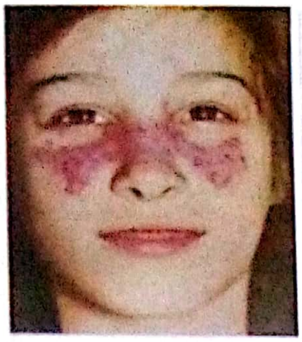
- **Infections (skin rash is essential diagnostic feature) : table page 263**
  - Measles: high fever and rash for 6 days.
  - Rubella: German measles. Mild fever and rash for 3 days
  - Roseola infantum: high fever and rash for one day
  - Scarlet fever: high fever and rash for 3-7 days
- **Other infections**
  - Infectious mononucleosis: fever, sore throat, lymphadenopathy and splenomegaly.
  - Typhoid fever: abdominal pain, fever and splenomegaly and may be rash.
  - Erythema infectiosum: Parvovirus B19: slapped cheek appearance, rash on trunk
  - Enteroviral infections: nonspecific rash.

2. Rheumatic diseases

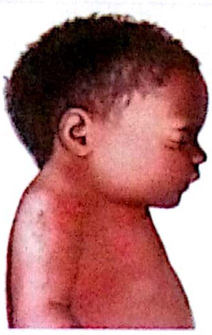
Rheumatoid arthritis	Systemic lupus	Dermatomyositis
· Fever	. Fever	. Fever
· Chronic arthritis	. Butterfly rash on the face	. Muscle pain
	. Renal and heart disease	. Weakness

3. Skin diseases

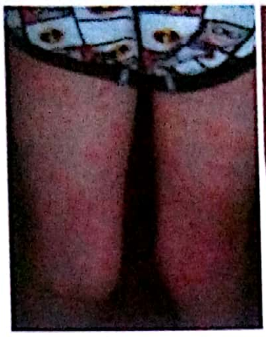
Drug rash	Sweat rash	Urticarial rash
· History of drug intake	. Fine papules	. Itching
· On the limbs mainly	. In the friction area	. Wheal



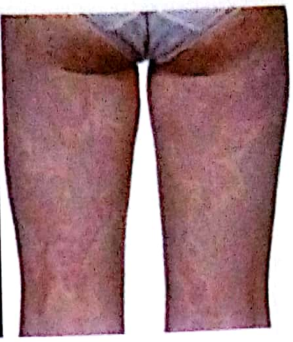
Systemic lupus



Sweat rash



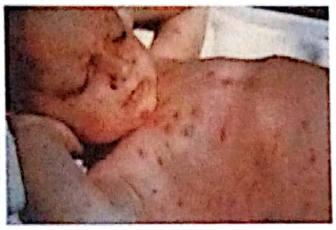
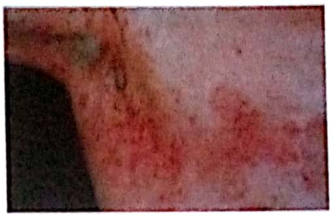
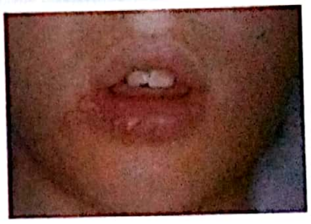
Drug rash



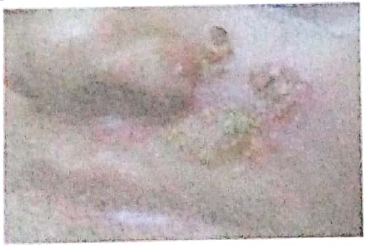
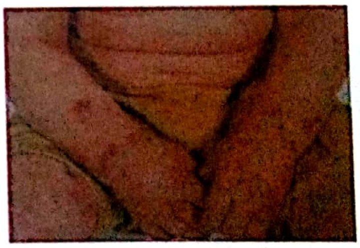
Urticarial rash

Causes (differential diagnosis) of vesicular rash

1. Infections

Chicken pox : P 264	**Herpes Zoster**	**Herpes simplex**
		
. Centipetal . Pleomorphic . Pruritic (itchy)	. Unilateral long the course of the nerves . Neuralgia(pain of nerve origin)	. Mucocutaneous junctions . High fever . Recurrent

2. Skin diseases

Impetigo contagiosa	**Papular urticaria**
. Skin infection (not in mucous membrane) by hemolytic streptococci or by staphylococci.	. Hypersensitivity reaction to allergen e.g. insect bite (so it is recurrent)
. Exposed areas of face and neck. 	. Extensor surface of extremities 
. Macules that rapidly change into vesicles. (The exudates dries to form thick crust :honeycomb crust)	. Papules, some of them may change into vesicles.

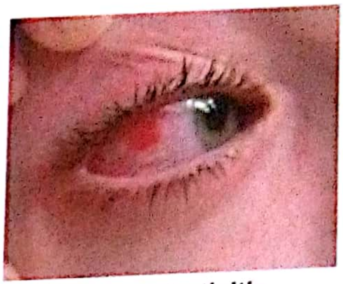
Measles

Etiology

- Measles virus
- Droplet infection

Clinical picture

- It starts after incubation period of 10 days.



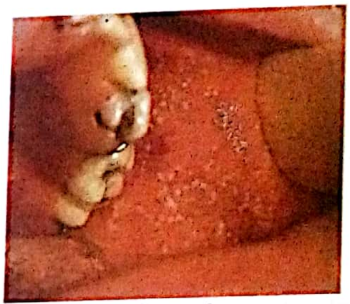
Conjunctivitis

Prodromal stage: significant for 4 days

1. Fever
2. Coryza (nasopharyngitis), Cough and Conjunctivitis.

Koplik spots pathognomonic: early diagnostic sign

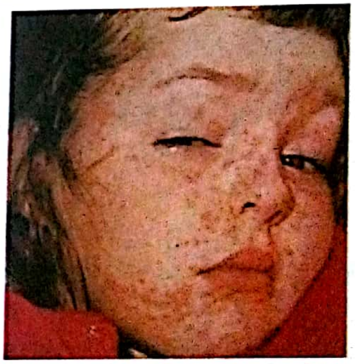
1. Onset: 2nd day of fever.
2. Offset: 3rd day of fever.
3. Site: buccal mucosa opposite the lower molar tooth.
4. Shape: grayish white dots surrounded by reddish areola.



Koplik spots

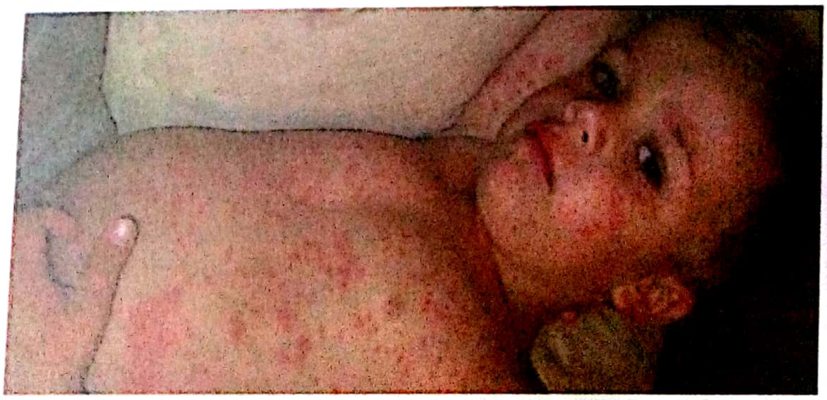
Rash

1. **Fever rash relationship**
   - Rash: appears on the 4th day of fever.
   - Fever: temperature rises sharply as rash appears, may reach 40 C°. It drops within 2 days
2. **Type:** maculopapular rash.
3. **Site at onset:** face (along the hair lines and behind the ears).
4. **Spread:** neck, trunk and limbs (mainly centripetal).



High fever - Rash on the face

5. **Final distribution**
   - 3days to become generalized.
   - 3 days to fade, starting on the third day by the same order of spread.
6. **Desquamation**: brownish pigmentation that may persist for 7-10 days.



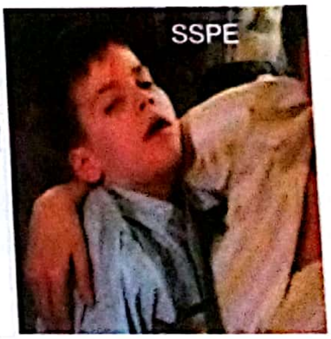
Complications

1. Respiratory

- Otitis media.
- Bronchitis.
- Larngotrachiobronchitis.
- Bronchiolitis.
- Bronchopneumonia (viral or secondary bacterial infection)

2. C.N.S

- Encephalomyelitis.
- Subacute sclerosing panencephalitis (SSPE)
  - It is caused by a variant of the measles virus which persists in the CNS
  - It presents years after measles usually 7 years.
  - Loss of neurological function, which progresses over several years to dementia and death.



3. Abdominal : gastroenteritis

4. keratitis , iritis and optic neuritis

Investigations

1. Blood picture: lymphocytosis
2. Serological tests : Measles IgM antibodies OR isolation of measles virus
3. CSF in suspected encephalitis
4. Chest x ray in suspected pneumonia

Treatment

1. Prevention

- Active: MMR at 12 months (discuss from immunization chapter).
- Passive: Immune serum globulin 0.25 ml/kg IM. It can prevent measles if given within 5 days after exposure.

2. Supportive treatment

- Diet: increase fluid intake.
- Drugs (symptomatic treatment)
  - Cough sedatives and nasal decongestants.
  - Antipyretics. Details page 276

3. Specific treatment

- In immunocompromised patients, the antiviral drug ribavirin may be used
- Oral vitamin A 400,000 IU (modulate the immune system) reduces morbidity and mortality.

4. Treatment of complications

- Otitis media and bronchopneumonia are treated by proper antibiotics.

Rubella (German Measles)

Etiology

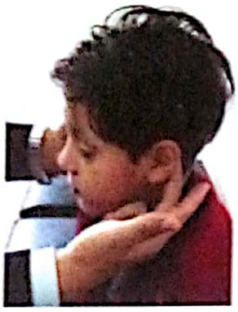
- Rubella virus (human being are the only reservoir)
- Droplet infection

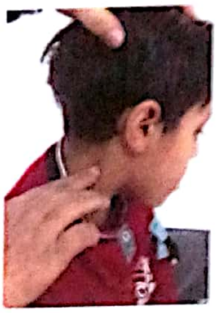
Clinical picture

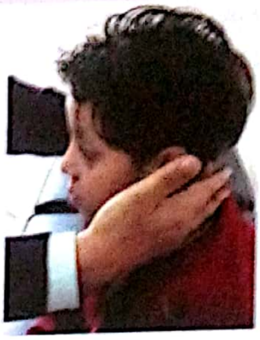
- ○ It starts after incubation period of 2-3 weeks

Prodromal stage: mild and short: 2 days: Mild fever, cough and coryza.

Lymphadenopathy: retro-auricular, posterior cervical and occipital.

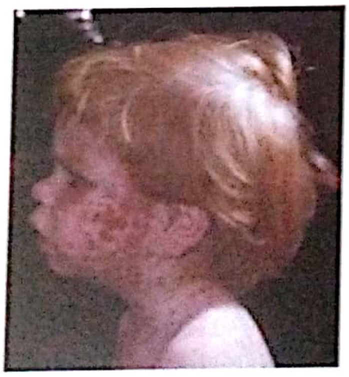


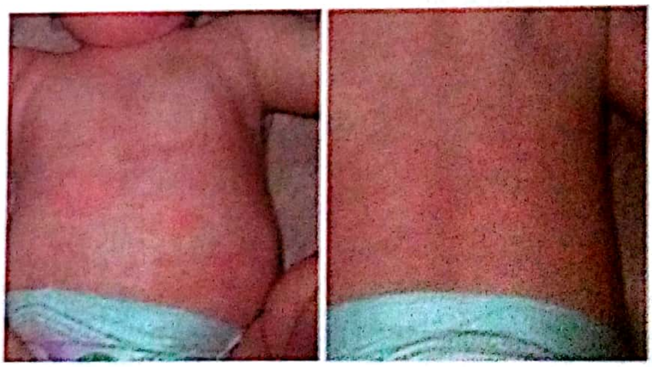




Rash

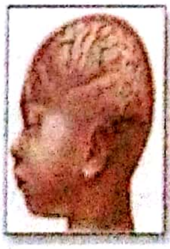
1. **Fever rash relationship:**
   - ➢ Rash: appears on the second day of fever.
   - ➢ Fever: is mild from the start.
2. **Type:** macules
3. **Site of onset**: face.
4. **Spread**: trunk and limbs.
5. **Final distribution**: fades on the face by time it appears on trunk, all rash duration. is 3 days
6. **Desquamation**: minimal.



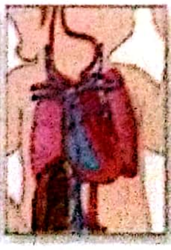


Complications: Uncommon in children (mild in children, more severe in adults)

1. Neurological : encephalitis
2. Arthritis
3. Thrombocytopenia
4. Congenital rubella syndrome →



Microcephaly



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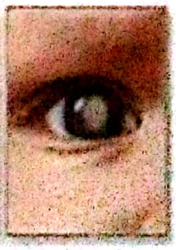


Cataracts

Roseola Infantum (Exanthem subitum)

Incidence: 6 months to 2 years.

Etiology

- Human herpes virus 6
- It tends to occur in spring.

Clinical picture

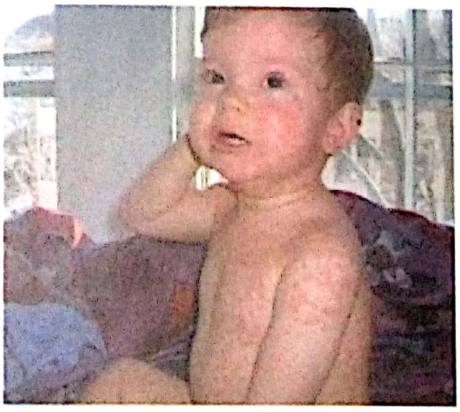
- It starts after incubation period of 1 week

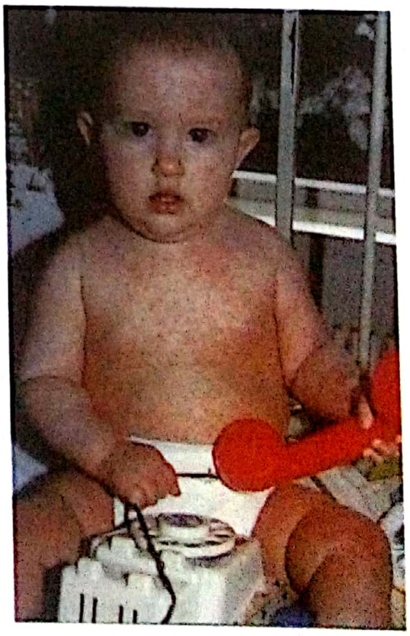
Prodromal stage

1. Fever: high (39-41 °C) without any localizing signs.
2. Fever may lead to febrile convulsions in susceptible infants

Rash

1. **Fever rash relationship**
   - Rash: Appears on the 4th day of fever.
   - Fever: temperature drops suddenly as rash appears.
2. **Type**: maculopapular.
3. **Site of onset**: trunk.
4. **Spread:** arms, neck, limbs with minimal face involvement.
5. **Final distribution**: fades in 24 hours.





Treatment

1. Antipyretics : Details, Page 276
2. Sedatives may be added in infants susceptible to febrile convulsions

Scarlet Fever

Etiology and epidemiology

- Group A beta hemolytic streptococci (erythrogenic toxin producing strain)
- It tends to occur in late winter and early spring
- It is common between 2-10 years, but no age is excepted.
- Both sexes are equally affected and it is endemic in most large cities.

Clinical picture

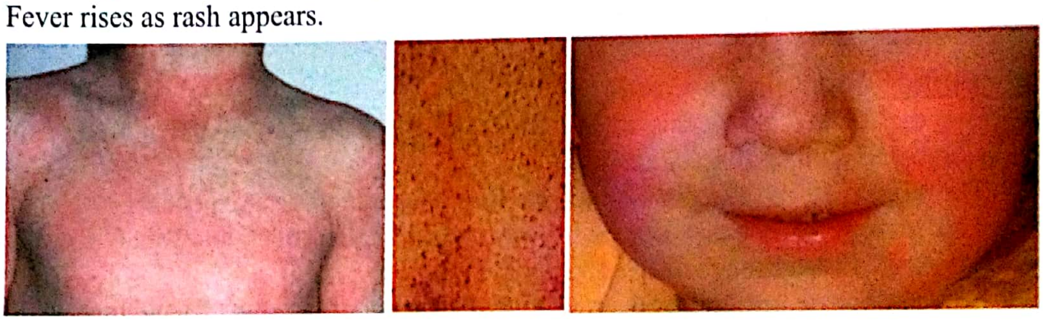
- It starts after incubation period of 2-4 days

Prodromal stage: 2 days

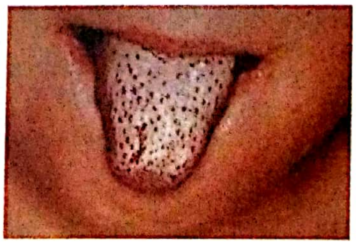
1. Fever (sudden, high: 39- 40 C°), anorexia, headache and malaise.
2. Sore throat, vomiting and abdominal pain.

Rash (Exanthem)

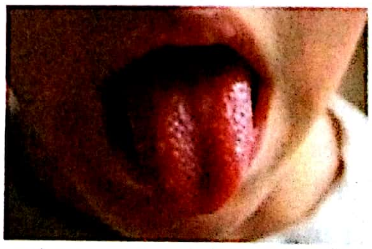
1. **Fever rash relationship**
   - Rash: appears on the second day of fever
   - Fever rises as rash appears.



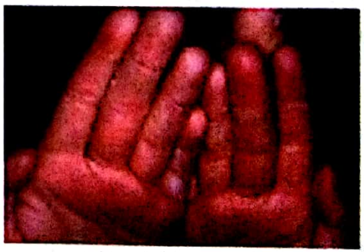
2. **Type**: Maculopapular
   - Fine papules that give the skin texture of sandpaper or gooseflesh appearance
   - Red punctate that blanches on pressure.
3. **Site of onset**: skin creases, base of neck and axilla.
4. **Spread**: Face: sparing the perioral area (circumoral pallor), trunk and limbs.
5. **Final distribution**: 24 hours to become generalized, 3-7 days to fade.
6. **Desquamation:** branny desquamation(begins on the face, proceed to trunk and limbs)



First few days: white strawberry



After 4-5 days: Red Strawberry



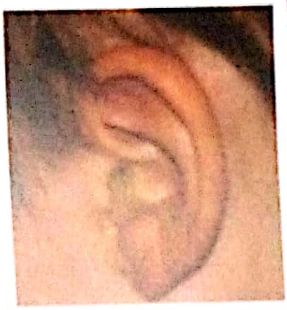
Skin desquamation

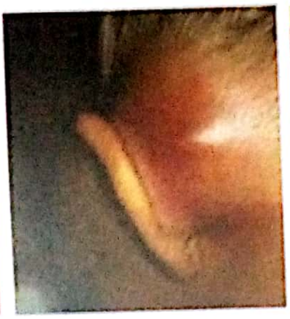
Mucous membranes (Exanthem)

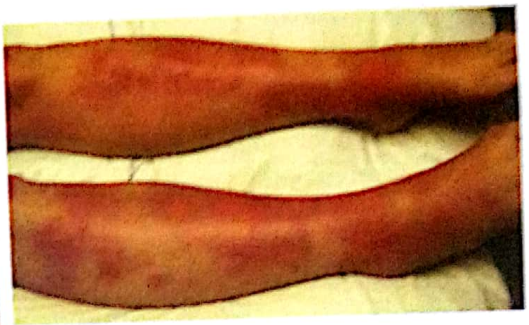
1. **White strawberry tongue** : it is covered white coat with red edematous papillae
2. **Red strawberry tongue**: peeling of the white coat, the tongue all is red
3. **Redness and edema** over the tonsils, pharynx, tongue and palate

Complications

1. **Local** spread of infection : SOML
   - Sinusitis, Otitis media, mastoiditis, Osteomyelitis and Septicemia.
   - Lateral Sinus thrombosis. Cervical Lymphadenitis
2. **Remote** autoimmune process occurring 2-3 weeks after acute infection
   - Rheumatic fever
   - Acute glomerulonephritis
   - Erythema nodosum


Otitis media


Mastoiditis


Erythema nodosum

Investigations

1. Blood picture: leukocytosis 10,000-20,000 of which 75-90% are polymorphs, usually associated with secondary anemia.
2. Throat culture: may be positive for group A beta hemolytic streptococci.
3. Evidence of recent streptococcal infection e.g. elevated antistreptolysin O titer.
4. Elevated acute phase reactants (bacterial infection)
   - Erythrocyte sedimentation rate (normal: first hour 3-7 mm- second hour 8-15 mm).
   - C reactive protein

Treatment

1. **Prevention**

   Prevention of droplet infections.
2. **Supportive treatment**
   - Diet: increase fluid intake.
   - Drugs: symptomatic treatment

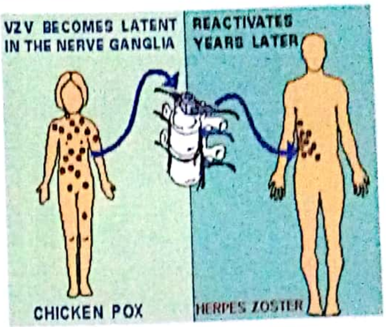
     Fever: antipyretics: details, Page 276

     Headache and pain: analgesics
3. **Specific treatment**
   - Penicillin is the drug of choice: oral penicillin V 400,000 IU/dose 4 times /day for at least 10 days
   - Erythromycin (40 mg/kg/day) in penicillin sensitive patients.
4. **Treatment of complications**
   - Re-examination after 2-3 weeks for detection and management of remote complications e.g. rheumatic fever.

Differential diagnosis of maculopapular rash

Measles	German measles (rubella)	Roseola infantum	Scarlet fever
Prodromal stage Significant : **4 days**	Mild and short : **2 days**	Significant : **4 days**	Significant : **2days**
- Fever(high), Coryza, cough and conjunctivitis	- Mild fever	- Fever (high 39-41C) only - No localizing signs	Fever(high), sore throat, vomiting and abdominal pain
- **Koplik spots** . Onset: 2nd day of fever . Offset: 3rd day of fever . Site: buccal mucosa . Shape: grayish white dots	- **Lymphadenopathy**: Retro-auricular, posterior cervicaland posterior occipital		**Tongue changes** . Early: white strawberry tongue. . Late: red strawberry tongue.
Rash **6 days**	**3 days**	**1 days**	**4-6 days**
Fever rash relationship - Rash: appears on the **4th day** - Fever: rises as rash appears	- Rash: appears on the **2nd day** - Fever: is mild from the start	- Rash: on the **4th day** - Fever: drops as rash appear	- Rash: appears on the **2nd day** - Fever: rises as rash appears
Type: Maculopapular rash	. Macular	. Maculopapular	. Fine papules (sandpaper like)
Site at onset: Face	. Face	. Trunk	. Skin creases
Spread Centripetal	. Centripetal	. Arms, neck, limbs	. Face: (circumoral pallor), trunk Limbs.
Final distribution - **3 days** to become generalized - **3 days** to fade, (by the same order of spread	.Fades on the face by time it appears on the trunk	. Fades in 24 hours	1 day to become generalized , 3-7 days to fade
Desquamation Brownish pigmentation	. Minimal		. Branny

Chickenpox(varicella)



Etiology

Varicella zoster virus

- Droplet or contact infection by fluid inside the vesicles.
- Dry scales are non-infective.
- Most common between 2-10 years (90% under 10 years) but it can occurs at any age , including neonates

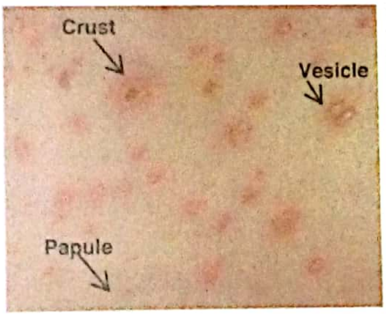
Clinical picture

- It starts after incubation period of 2-3 weeks.

Prodromal stage: 1- 2 days, mild and may be absent (mild fever, anorexia, headache, malaise)

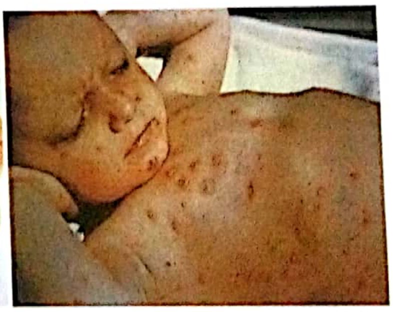
Rash

1. Type
   - Papulovesicular rash
     Begins as papules that rapidly change into vesicles on an erythematous base, on the second day it produces a crust that falls *usually* with no scar.
   - Pleomorphic: as it appears in successive crops over 3- 4 days.
   - Pruritic: Itchy
2. **Site of onset**: trunk (centripetal distribution)
3. **Spread** : Face, scalp, mucous membrane of the mouth and proximal parts of limbs
4. **Final distribution**: 1 week from papules of the first crop to crusts of the last crop.



Pleomorphic

Pruritic



Mainly in the trunk

Differential diagnosis of vesicular rash Page 256

Complications: uncommon, most cases recover completely

1. **Secondary bacterial infections (staph., streptococci)**→ cellulitis and sepsis
2. **C.N.S**:
   - Encephalitis or meningitis.
   - Myelitis and polyradiculitis
   - Cerebellitis: occur within a week of the illness and presents with ataxia.
3. **In Immuno compromised e.g. children receiving corticosteroids**
   - Disseminated infection and pneumonia → fatal chickenpox

Treatment

1. **Prevention**
   - Active: live attenuated varicella vaccine
   - Passive: Human varicella zoster immunoglobulin, given in immunocompromised?
2. **Supportive treatment**
   - Anti-pruritic agents (local and systemic) for itching.
   - Antipyretics- not aspirin- as it increase the risk of Reye syndrome in which there is acute encephalopathy and fatty degeneration of the liver.
3. **Specific treatment**
   - Antiviral drugs (Acyclovir) IV indicated in
     - Immunocompromised children
     - Cases complicated by pneumonia or encephalitis.
4. **Treatment of complications**
   - Antibiotics in secondary bacterial infections only

Herpes simplex infections

Incidence

It is very common infections with various presentations.

Etiology

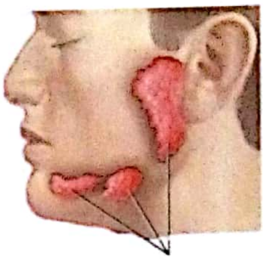
- Herpes virus (type I): skin and eye infection, spreads by infected saliva.
- Herpes virus (type 2): genital infection spreads by sexual contact.

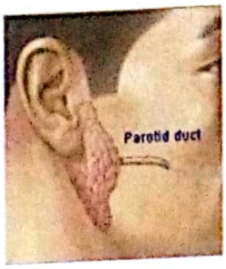
Clinical presentations

1. **Neonatal infections**
   - It occurs if the mother has genital herpes infection Type 2 at the time of delivery
   - It presents with:-
     - Vesicular rash and Bleeding.
     - Hepatosplenomegaly.
     - Encephalitis: presenting with lethargy and seizures.
   - Cesarean section is indicated.
2. **Acute gingivostomatitis** :painful oral lesion : gastroenterology chapter : Page
3. **Cold sores:** Recurrent infection presents as cold sores around the mouth.
4. **Keratoconjunctivitis:** eyelid edema and dendritic corneal ulcers.
5. **Meningoencephalitis** : discussed in neurology chapter: page
   - It is common cause of Meningoencephalitis, occurs even in absence of skin lesions
   - The illness is severe with high mortality.
   - EEG : temporal lobe abnormalities
   - Acyclovir is the drug of choice.

Mumps (Epidemic Parotitis)

Etiology and epidemiology





- Myxovirus (transmitted by droplet infection)
- It occurs between 5-15 years
- Both sexes are equally affected
- More common in winter and spring

Clinical picture

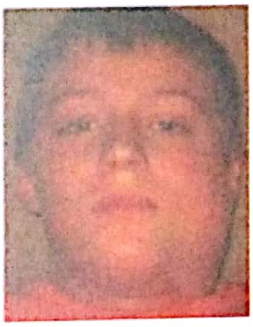
- It starts after incubation period of 2-3 weeks

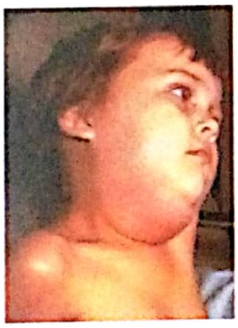
Prodromal stage

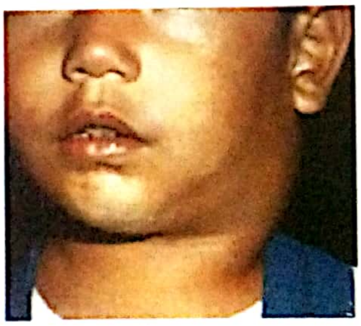
1. Non specific and rarely defined.
2. Fever, anorexia, headache and malaise.

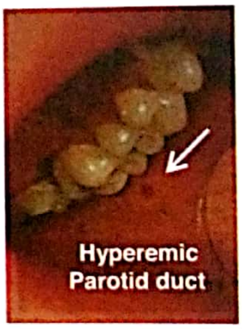
Salivary glands swellings

1. **Parotid gland**
   - **Incidence**: The commonest gland to enlarge.
   - **Picture**: Painful parotid swelling (one or commonly both glands with one day apart).
     - Pain: around the ear, aggravated by chewing movements or sour drinks.
     - Parotid swelling
       - Fills the space behind the mandible.
       - Tender and better seen than felt
       - Raises the ear lobule and extends anterior to it.
       - Reaches maximum size in 1-3 days, subsides in 7 days.
     - Parotid duct opening is hyperemic (obstructed) → dry mouth
2. **Submandibular gland:** usually enlarges with the parotid.
3. **Sublingual gland:** least common but extremely painful.





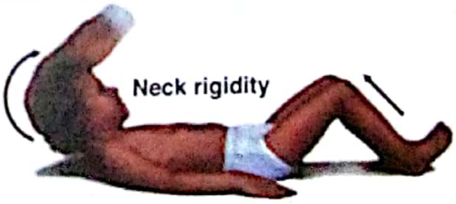


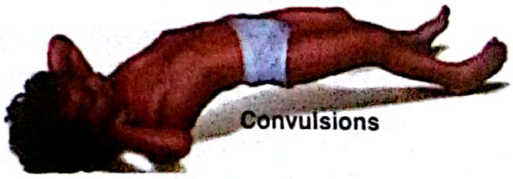


Complications

1. Meningo-encephalomyelitis

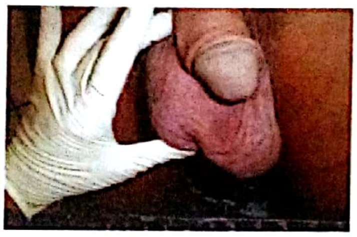
- Onset: usually occur 3-10 days after parotitis, it may be isolated.
- Picture: fever, headache, vomiting-neck rigidity and convulsions.
- C.S.F: ↑ proteins, Normal sugar and ↑ lymphocytes





2. **Pancreatitis**
   - Onset: follows parotid swelling by 10 days (or isolated
   - Picture of acute abdomen:
     - Fever, acute epigastric pain, vomiting.
     - Diffuse tenderness
   - Elevated serum amylase and lipase.

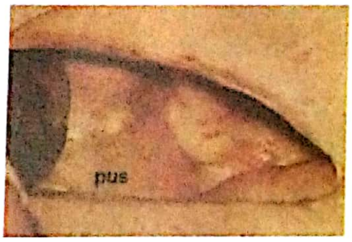
3. **Epididymoorchitis (mainly in adolescence)**
   - Onset: follows parotid swelling by 10 days or it may be isolated.
   - Picture: fever, lower abdominal pain and swollen tender testis.
   - Atrophy and impaired infertility in 13%

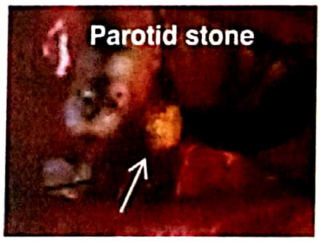


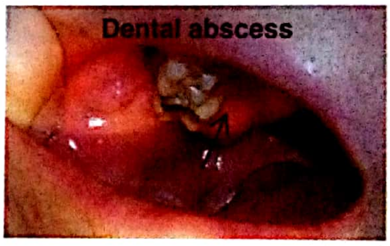
4. **Rare complications** e.g. deafness, myocarditis and optic neuritis

Differential diagnosis

1. **Other parotid swellings**
   - Recurrent parotitis: viral ,or allergic in origin- recurrent.
   - Suppurative parotitis : pain, toxemia and pus from the gland duct.
   - Calculus obstruction or stenosis of the duct: intermittent swelling




Parotid stone


Dental abscess

2. **Cervical lymphadenopathy**: firm, well defined border, multiple, special site
3. **Dental conditions:** e.g. dental abscess

Treatment

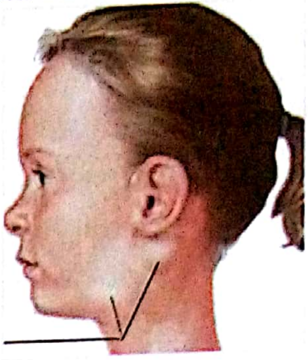
1. **Prevention**
   - Active: Mumps vaccine or MMR
   - Passive: hyperimmune mumps gamma globulins (of value if given early in the incubation period)
2. **Supportive treatment**
   - Measures to relieve pain:-
     - Analgesics.
     - Parotitis: heat to the glands.
     - Orchitis: ice bags - support the testis.
   - Mouth: anti septic solutions to keep it clean.
3. **Specific treatment** : No specific treatment.
4. **Treatment of complications e.g.**
   - Encephalitis: control of convulsions and measures to lower the increased tension.

Infectious Mononucleosis (glandular fever)

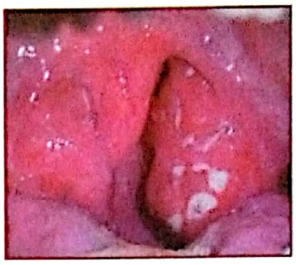
Etiology

- Epstein Barr virus: kissing disease
- It occurs most often in adolescence and adults , however children are commonly affected

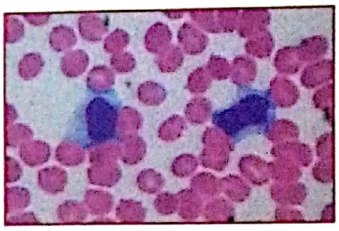
Clinical picture



1. Incubation period: 4-14 days
2. Insidious onset.
3. Anorexia, malaise, fatigue, fever and sore throat.
4. Tonsils may show white exudates.
5. Cervical lymphadenopathy and splenomegaly.
6. Maculopapular rash: may appear if ampicillin is used.



Investigations



1. Blood picture: Atypical lymphocytes .
2. Monospot test.
3. Eb virus IgM (+ve with recent infection).
4. VCA (Viral Capsid Antigen) or EBNA (EB nuclear antigen)

Treatment

No specific treatment- symptoms may persist for weeks or even months

Incubation and school exclusion period of common childhood infections

	Incubation	Period of infectiousness	School exclusion
Measles	10 days	10 days : 1 days before rash appearance to 6 days after	5 days from onset of rash
Rubella	2-3 weeks	Last week of incubation period to 5 days after	5 days from onset of rash
Chickenpox (varicella)	2-3 weeks	1 day before rash appearance up to 5 days after it disappears.	Until all lesions have crusted
Mumps	2-3 weeks	Not known	7 days from onset of parotitis
Scarlet fever	2-3 days		
Pertussis	1-2 weeks		
Tetanus	3-14 days		
I.mononucleoss	3-14 days		

Tetanus

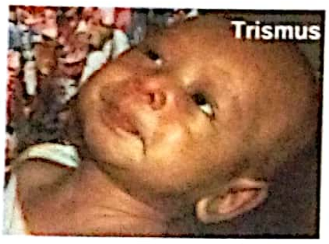
Etiology

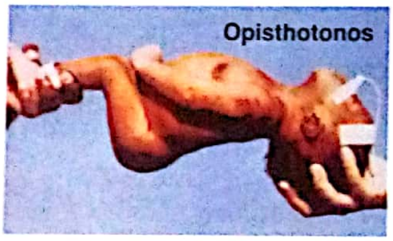
- **Organism**
  - Clostridium tetani: Gram +ve bacilli anaerobic bacilli (spore forming)
  - The vegetative form produces powerful neurotoxin

- **Mode of transmission**
  - Contamination of wounds by tetanus spores
  - Neonates: contamination of umbilical stump by unclean cutting or dressing

Clinical picture

1. **Progressive intermittent painful stiffness of voluntary muscles**
   - Jaw: trismus (lock jaw) with failure to suck in neonates.
   - Spasm at angle of mouth (risus sardonicus).
   - Back: opisthotonos.
   - Neck: neck rigidity.
2. **Generalized convulsions on minor visual, auditory or cutaneous stimuli**





Complications

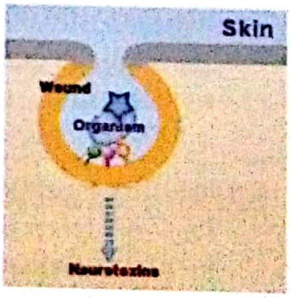
1. Respiratory: Atelectasis – Pneumothorax – emphysema.
2. Vertebral fractures.

Differential diagnosis

1. Meningitis, epilepsy, rabies.
2. Tetany (carpopedal spasm).

Treatment

1. **Prevention**
   - DPT (discuss).
   - Tetanus toxoid during pregnancy for prevention of tetanus neonatorum.
   - Following injury : if the patient is not immune, human antitetanus immunoglobulin
2. **Supportive treatment**
   - Isolation and nursing in a dark quiet room.
   - Control of convulsions (patent airway, oxygen and Diazepam)
3. **Specific treatment**
   - Human tetanus immunoglobulin.3000-6000 units IM
   - Antibiotics to eradicate the organism: Penicillin G.
   - Wound:-cleaned, left opened and deprided.



4. **Treatment of complications**: respiratory support for cases with asphyxia.

Diphtheria

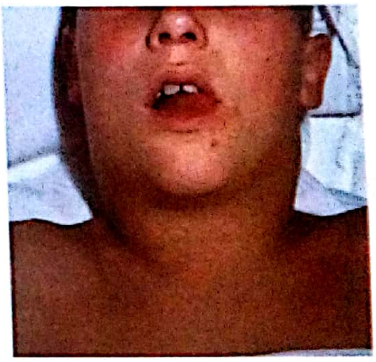
Etiology

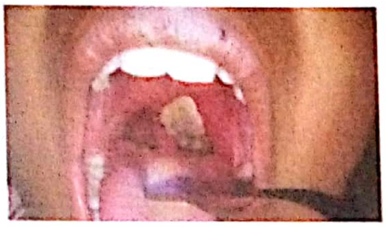
- Diphtheria bacilli – gram positive
- The incidence decreased markedly after routine vaccination

Clinical picture

- It starts after incubation period of 2-7 days.
- Manifestations depend on the site of infection.

1. **Pharyngeal (faucial diphtheria)**
   - General: manifestations of toxemia (rapid pulse – low blood pressure)
   - Local
     - Pharynx: membrane is formed on the tonsils
     - Neck: huge enlargement of cervical lymph nodes
2. **Laryngeal:** hoarseness of voice and stridor)
3. **Nasal** :offensive blood stained nasal discharge





Complications

1. **CVS:** .toxic myocarditis and heart failure
2. **Respiratory :** laryngeal obstruction and bronchopneumonia
3. **C.N.S:** Post diphtheritic paralysis: see acute paralysis

Differential diagnosis

1. **Pharyngeal** from other causes of pharyngeal membrane
   - Acute follicular tonsillitis
   - Infectious mononucleosis
   - Agranulocytosis and leukemia
2. **Laryngeal:** from other causes of stridor

Treatment

1. **Prevention:** DPT vaccination.
2. **Specific treatment**
   - Antitoxin to neutralize the exotoxin

     40,000- 100.000 units I.M or 1/2 I.M and 1/2 I.V in severe cases
   - Antibiotic to eradicate the organism
     - Penicillin 600,000 I.U for 7-10 days
     - Erythromycin 40 mg/kg/ day for penicillin sensitive patients for 7-10 days.
3. **Supportive treatment and treatment of complications**
   - Rest: complete bed rest if myocarditis is diagnosed
   - Proper hydration and high caloric intake
   - Tube feeding for patients with palatal or pharyngeal paralysis to avoid aspiration

Fever

Definition

Elevation of body temperature above: 37.8 ° C (orally) or 38 ° C (rectally). Fever is not a disease by itself but it is a symptom.

Pathogenesis

Exogenous pyrogens (toxins, infectious agent or immunological agents) release endogenous pyrogens (mediators) from phagocytic cells that act on hypothalamus (thermoregulatory area) releasing prostaglandins and monoamines which cause the fever.

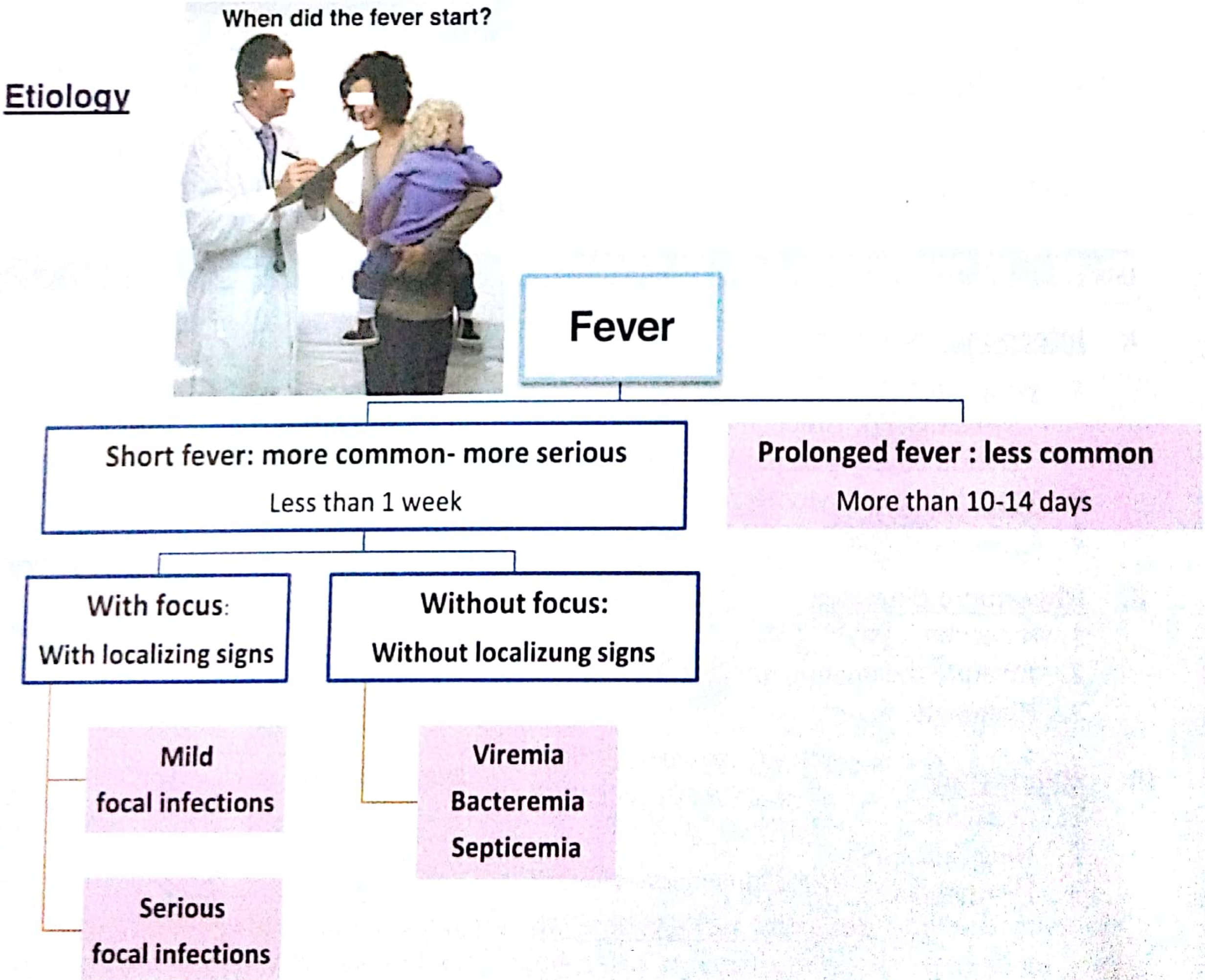
Grades

According to the *rectal temperature* which is more accurate

- **Mild fever:** 38 to 38.4° C
- **Moderate fever:** 38.5 to 39.4° C
- **High fever:** 39.5 to 41° C
- **Hyperpyrexia:** above 41° C (in serious bacterial infections e.g. meningitis)

Hyperthermia is elevation of body temperature due to external heating (not due to hypothalamic thermo regulatory mechanism) but. e.g. high incubator temperature in neonates or heat stroke in children

Etiology



Short fever: less than one week

I. Fever with focus: with localizing signs: diagnosis is by clinical findings.

- **Mild focal (simple) infections: the commonest causes of fever**
  1. Respiratory: tonsillitis, sinusitis, nasopharyngitis, otitis media, bronchitis.
     - ➢ Otitis media is very common in infants and children, examination should always include ear examination with otoscope.
  2. Gastrointestinal: e.g. gastroenteritis (vomiting and diarrhea).
     - ➢ Vomiting is not localizing sign as it accompanies infections of many systems.
  3. Urinary: e.g. cystitis (dysuria, frequency).
  4. Skin: abscess.
- **Serious focal infections: clinical exclusion of serious focal infections**
  1. Pneumonia: respiratory distress, bronchial breathing and crepitations.
  2. Peritonitis: abdominal distention and diffuse tenderness.
  3. Pyelonephritis: loin pain and tenderness.
  4. Meningitis: convulsions, neck retraction, increased intracranial tension.
  5. Arthritis or osteomyelitis: hotness, redness, tenderness and swelling.

II. Fever without focus : without localizing signs (simple fever)

- Viremia
- Bacteremia
- Septicemia

Prolonged fever: more than (10-14 days): less common

I. Infections (most common)

1. **Bacterial**
   Systemic: TB, Brucellosis, and Salmonellosis.
   Localized: Pyelonephritis, endocarditis, abscesses e.g. liver, pelvic and perinephric.
2. **Viral**: hepatitis, cytomegalovirus, infectious mononucleosis.
3. **Parasitic**: Malaria, toxoplasmosis, visceral larva migrans.

II. Rheumatic diseases

1. Systemic lupus
2. Juvenile rheumatoid arthritis
3. Rheumatic fever.

III. Malignancy

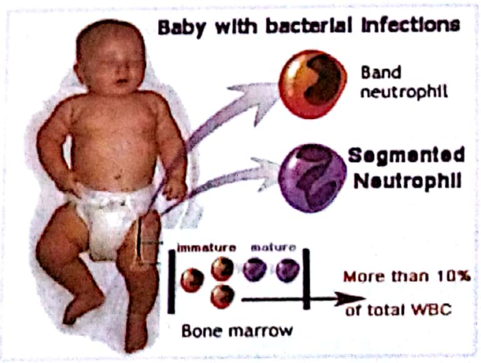
1. Leukemia
2. Neuroblastoma
3. Lymphoma.

Fever Without Focus: nonspecific febrile illness

The most important step is to differentiate between viral infections (viremia) and bacterial infections (bacteremia, septicemia)

General clinical scale (assessment) is available for prediction of serious illness of bacterial and non-bacterial and includes:

- **History**
  1. Appetite
  2. Activity
  3. Reaction to parents' stimulation
  4. Response to social stimulation: smiles, expressionless look or irritable
- **Examination**
  1. Consciousness level
  2. Color
  3. Cry quality
  4. Appearance: normal or sick

Viremia	Bacteremia
1. Fever . Mild to moderate	. High fever
2. General clinical assessment . Fair general condition	. Bad general condition
3. Investigations . **Complete blood count** Leukocytosis usually less than 15,000 cells/mm^3.	. Leukocytosis above 15,000 cells/ mm^3 or less than 5000 cell/ mm^3 . Band count above 10% of the total white cell count (normal less than 5%)  Baby with bacterial infections Band neutrophil Segmented Neutrophil immature mature More than 10% of total WBC Bone marrow
. **Acute phase reactant** C Reactive Protein and ESR are normal or mildly elevated	CRP: increased: 20-30 mg/liter.(N: < 10mg/L) ESR: above 20millmitre in the first hour(N: 3-7 mm)
4. Treatment Antipyretics	Broad spectrum antibiotics
5. Re-examination after one or two days is important as it may reveal the focus of infection	**Re-examination** after one or two days is important especially when Investigations are not available

Management of septicemia

1. **Clinical diagnosis**
2. **Immediate Investigations**
3. **Urgent treatmnet**

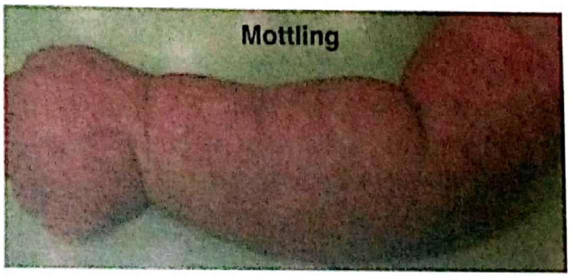
Clinical diagnosis

History

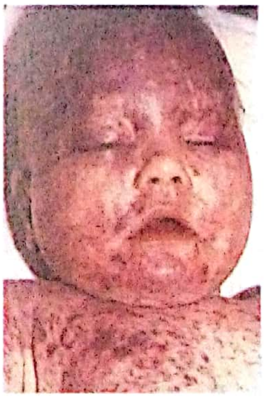
1. High fever or hyperpyrexia.
2. Poor Feeding with persistent vomiting.
3. History of focal infection, e.g. meningitis, osteomyelitis, gastroenteritis, cellulitis.

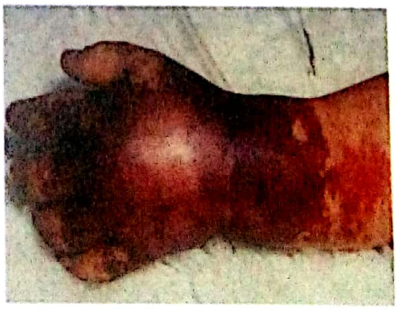
Examination: very bad general condition

1. Appearance: very ill, toxic and miserable.
2. Conscious level: lethargy or unconscious.
3. Color: pallor and may be purpuric rash (meningococcal septicemia).
4. Cold extremities and mottled skin.



5. Picture of Complications or advanced septicemia
   - Toxic encephalopathy: disturbed consciousness and convulsions
   - Hematological complications:
     - Acute hemolysis due to direct destruction of red cells by toxins.
     - Thrombocytopenia due to direct destruction of platelets→ purpura.
     - Disseminated intravascular coagulopathy: effect of toxins, shock and sepsis.
   - Other septic complications
     - Septic shock (combination of hypovolemic , cardiogenic and distributive shock)
     - Septic acute renal failure due to toxemia and shock.
     - Septic focal infections: meningitis, pneumonia, osteomyelitis, arthritis
     - Sclerema (skin hardening): fetal complications in neonates and young infants





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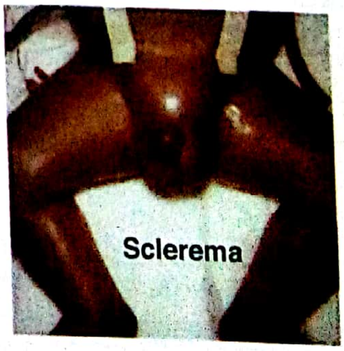
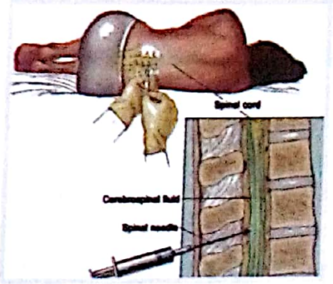


Immediate Investigations: septic screen

1. Complete blood picture: leukocytosis above 15000 cells/mm^3 or less than 5000 cell/mm^3 or the presence of band count above 10% of the total WBCs.
2. Acute phase reactants: CRP (above 20mg/litre)- ESR (above 20mm in the first hour).
3. Cultures: blood and urine blood culture is positive only in 50% of cases.
4. Swabs from eyes, ear, throat, umbilicus and rectum.
5. CSF examination to exclude meningitis.
6. Chest x ray to exclude pneumonia



Treatment: Urgent hospitalization is lifesaving to:-

Perform Immediate Investigations + **Start Parenteral Antibiotics** + **Observe and Manage Complications**

1. **Parenteral antibiotics : choice depend on the child' age**
   Initial combined broad spectrum antibiotics (ampicillin or amoxicillin and gentamicin), then change treatment according to the results of culture.
2. **Fluids to correct hypovolemia:** fluid misdistribution (loss) occurs due to the release of vasoactive mediators by host inflammatory and endothelial cells.
3. **Circulatory support:** Inotropic support may be required as inflammatory cytokines and toxins depress myocardial contractility.
4. **Hematological support :**
   If bleeding occurs, fresh frozen plasma and platelet transfusions.

What are the causes of fever with purpuric rash: fever with petechial rash?

1. **Serious bacterial infections: 20% of cases:** Discuss management of septicemia
   - Meningococcal septicemia : the commonest cause of sepsis in childhood
   - Haemophilus influenzae type b, Staphylococci, streptococci and Listeria.
2. **Viral causes: 80% of cases**
   - Enterovirus infection especially Echovirus type 9 (the most common)
   - Hemorrhagic fevers (Dengue fever, black measles) and Cytomegalovirus

Prolonged Fever

Definition

- Fever with duration more than 10-14 days
- Fever of unknown origin or unexplained prolonged fever: It is term used only when there is:
  1. History of prolonged fever (more than 10-14 days)
  2. Fever is documented in the hospital.
  3. History, examination, and routine investigations failed to reveal a cause.

Etiology

1. **Infections** (most common)
   - **Bacterial**
     - Systemic: TB, Brucellosis, Salmonellosis.
     - Localized: Pyelonephritis, endocarditis, abscesses e.g. liver, pelvic and perinephric.
   - **Viral**: hepatitis, cytomegalovirus, infectious mononucleosis.
   - **Parasitic**: Malaria, toxoplasmosis, visceral larva migrans.
2. **Rheumatic diseases**
   - Systemic lupus, Juvenile rheumatoid arthritis and Rheumatic fever.
3. **Malignancy**
   - Leukemia, neuroblastoma and lymphoma.

- ✗ Prolonged fever is not as common as short fever
- ✗ Most cases are due to benign infections and the prognosis is usually good

Management of prolonged fever or (fever of unknown origin)

1. **Fever documentation is very important as parents may misinterpret**
   - ○ Normal temperature as fever.
   - ○ 2 short febrile illness as one prolonged fever.

2. **History and examination may suggest a cause.**
3. **Investigations are then directed to the most likely diagnosis.**

- ➢ **Home management** for patients with good general condition and normal outpatient laboratory findings (CBC, ESR, CRP, urine analysis) → benign viral infection
- ➢ **Hospital management** for patients with nonspecific findings denoting significant illness.
  - Anorexia , weight loss
  - Toxic look, pallor, cachexia, weight loss, lymphadenopathy or hepatospneomegly

In the hospital, investigations and observations for appearance of new symptoms and signs are the most important measures

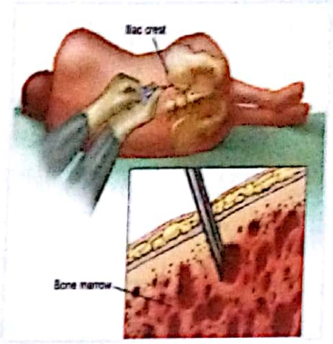
Investigations

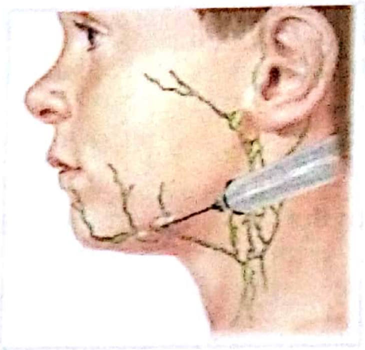
Initial investigations

1. CBC, ESR and CRP: positive findings indicate significant illness.
2. Urine and blood culture.
3. Serological tests: Widal (typhoid fever)-Monospot test (infectious mononucleosis)
4. Tuberculin test.
5. Chest X ray: may reveal pneumonia or lung infiltrate.

Further investigations if the above tests are unrevealing include:-

1. Abdominal ultrasonography may reveal liver abscess or pelvic abscess.
2. Echocardiography may reveal vegetations of infective endocarditis.
3. Bone marrow examination may reveal malignant cells.
4. Lymph node biopsy.





Management of a febrile patient in general

Supportive treatment of fever

1. Bed rest.
2. Diet: excess fluids to avoid dehydration and soft diet.
3. Supplementation with multivitamins in cases with prolonged dietary restriction.
4. Antipyretic measures
    - Antipyretics can be given (oral or rectal) every 4-6 hours e.g. Paracetamol: 10-15 mg/kg /dose or Ibuprofen: 10-15 mg/kg/ dose.
    - Fomentation with tap water is not as effective as antipyretic medications.

Specific treatment

1. **Short fever**
    - Antibiotics should be used only for the specific bacterial disease.
    - Type of antibiotic: depend on the clinical diagnosis and the result of investigations.
    - Route and duration:
        - Mild infections e.g. otitis media: oral for 5 to 7 days.
        - Serious infections: parenteral combined antibiotics for 10 to14 days.

2. **Prolonged fever**

   In fever of unknown origin, empirical drug therapy should be avoided as it may mask the condition and make diagnosis more difficult, however exceptions are:-
    - Antibacterial drugs if septicemia is clinically suspected (as in septicemia the causative organism can be identified in only 50%).
    - Antituberculous drugs if tuberculosis are strongly suspected in spite of negative laboratory findings

Vaccination

Compulsory vaccines in Egypt

Time	Vaccine or Toxoid	Dose
At birth	Polio Sabin(OPV) BCG	0.1 ml(intradermal) in the left deltoid 2 drops oral
2 months	Polio Sabin DPT Hepatitis B vaccine Hemophilus influenza Hib	2 drops oral 0.5 ml intramuscular: first dose 0.5 ml intramuscular : first dose 0.5 ml intramuscular : first dose
DPT, Hib, and hepatitis B vaccines are combined in one injection: Pentavalent		
4 months	Polio Sabin DPT Hepatitis B vaccine Hemophilus influenza Hib	2 drops oral 0.5 ml intramuscular :2nd dose 0.5 ml intramuscular : 2nd dose 0.5 ml intramuscular : 2nd dose
6 months	Polio Sabin DPT Hepatitis B vaccine Hemophilus influenza Hib	2 drops oral 0.5 ml intramuscular: 3rd dose 0.5 ml intramuscular: 3rd dose 0.5 ml intramuscular: 3rd dose
9 months	Polio Sabin+ Vitamin A	2 drops oral
12 months	Polio Sabin(OPV) MMR	2 drops oral 0.5 ml intramuscular .
18 months	Polio Sabin (OPV MMR DPT Hemophilus influenza Hib	2 drops oral 0.5 ml intramuscular 0.5 ml intramuscular: 3rd dose 0.5 ml intramuscular: 3rd dose
4 years and half	Sabin (OPV) DT	2 drops oral 0.5 ml intramuscular

BCG

Preparation

- Live attenuated strain of Bovine type.

Precautions

1. If vaccination is delayed after the first year, tuberculin test should be done and only tuberculin -ve are vaccinated.
2. Not to be given in cases of immunodeficiency

Advantages

1. It forms a localized focus of infection that stimulates the immune system.
2. It prevents severe disease e.g. miliary TB and TB meningitis.

Disadvantages

1. Limited protective value (but it is the only proved method for protection).
2. Axillary lymphadenopathy if given S.C→ BCGoma which may need anti TB therapy
3. Poor healing or ulceration may occur at the site of injection

Polio vaccine: Sabin

Preparation: Live attenuated vaccine containing the 3 polio. Strains.

Precautions

1. Cold chain system for keeping and transporting the vaccine
2. Not to be given during : gastroenteritis, acute infections or immunodeficiency.
3. In breast –fed infants, give the vaccine 1 hour before or after feeding.

Advantages

1. Cheap.
2. Gives local GIT immunity and humoral immunity.
3. High long lasting protective value 95%

Disadvantages

1. Easily inactivated.

DPT

Preparation

- Diphtheria and tetanus toxoid+killed Pertussis bacteria all are Alum absorbed
- This combination - Decreases the number of injections

Precautions: not to be given in

1. Febrile states
2. History of convulsions or epilepsy
3. Children more than 6 years give, only DT

Advantages:

1. High protective value

Disadvantages

1. Mild fever within 12-24 hours.
2. Convulsion (if it occurred, the infant should receive only DT in further vaccinations).
3. Local reaction at the site of injection.

Hepatitis B vaccines

Preparation: Recombinant DNA vaccine prepared from coding of HbsAg.

Advantages

1. High protective value.

Disadvantages

1. Transient erythema and induration at the injection site.
2. Mild fever and headache.

MMR

Preparation: Live attenuated vaccine containing the 3 types (measles, rubella and mumps).

Disadvantages: Fever and coryza may occur 6-10 days after injection (generally safe vaccine).

Hemophilus influenza Hib: compulsory now in Egypt

Preparation: Capsular polysaccharide vaccine

Advantages: It protects against meningitis, epiglottitis, and septicemia

Bacterial vaccines

Pneumococcal vaccines		2- Meningococcal vaccine	3- DT vaccine
Pneumococcal Conjugate **(PCV-13)**	**Pneumococcal PolySaccharide** **PPSV**		
▪ **Preparation** . Capsular polysaccharides bound to a diphtheria toxoid →higher immune response . Protects against 13 serotype	Capsular polysaccharides → Lower immune response Protects against 23 serotype	Capsular polysaccharide	Diphtheria and tetanus toxoids
▪ **Administration** **1. Dose:** 4 doses 0.5 ml (lifelong protection) **2. Route :** IM **3. Timing** . 2,4,6 months . Booster dose at 18 months with DPT, Hib and oral polio. . PCVs are among the routine vaccination in many countries	**1. Dose:** 1 doses 0.5 ml (not lifelong) **2- Route :** IM **3- Timing** . Above 2 years . Given in children at high risk of pneumococcal disease e.g. Sickle cell anemia, asplenia, HIV or immunocompromised	One dose 0.5 ml Subcutaneous Above the age of 2 years. Immunity only for 2 years Only indicated during epidemics of meningococci type A or type C	One dose : 0.5 ml IM Above 6 years. as pertussis vaccine is contraindicated

Non-compulsory vaccines

Viral vaccines

1- Rotavirus vaccine	2- Chickenpox	3- Hepatitis A	4- Seasonal Influenza	5- Rabies vaccine
▪ **Preparation** Live attenuated (mono or pentavalent)	Live attenuated	Inactivated virus	Inactivated (trivalent)	live attenuated
▪ **Administration** 1- **Dose**: - 2 doses at the age of **2 and 4** months for monovalent type - 3 doses at the age of **2,4,6** months for pentavalent	One dose 0.5 ml	2 doses 0.5ml with 6 months interval	One dose 0.5 ml for children above 3years old 0.25 ml in children between 6-36 months old.	5 doses , 1 ml at 0,3,7,14 and 28 days Human diploid vaccine
2- **Route** : oral	IM or SC	IM	IM or SC	IM
3- **Timing** . The first dose should not be given after the age of 16 weeks- and all doses of vaccines should be finished before 8 months. . Contraindicated in Immunodeficiency History of intussusception	Above 1 year Booster dose at 4-6 years	. Above 1 year	Above 1 year especially in cases with cardiac disease, metabolic disease, asthmatics and immunodeficiency	Post exposure is immediately indicated if the biting animal is unavailable

Resuscitation In The Delivery Room

Definition

It is a procedure applied to neonates who fail to spontaneously establish spontaneous respiration.

Incidence

Most infants do not require any resuscitation

- 10% of newborns will require some assistance to begin breathing
- Less than 1% needs extensive resuscitation to survive.

Aim of resuscitation

Prevent or limit neonatal morbidity and mortality that may occur during the first few hours

Physiological considerations

In problem that results in abnormal blood flow or oxygen supply in utero and or during delivery may compromise the fetus or newborn, apnea is the first sign of perinatal stress.

1. **Primary apnea** (heart rate and blood pressure are maintained). It is caused by brief hypoxia just before delivery. Recovery is by stimulation and oxygen exposure.
2. **Secondary apnea** (hear rate and blood pressure fall) occurs if hypoxia continues. It requires resuscitation by positive pressure ventilation (assisted ventilation).
   When a baby is born apneic and flaccid assume that it is secondary apnea and start positive pressure ventilation immediately.

Steps of resuscitation before delivery: anticipation and preparation

A. Anticipation of problems by good history taking considering:

1. Maternal risk factors e.g. hypertension.
2. Expected delivery problems e.g. fetal distress.

B. Preparation of:-

1. **Equipment**
   - Radiant warmer.
   - Suction equipment: suction machine, catheters.
   - Oxygen delivery equipment: bag and mask. stethoscope
   - Intubation equipment (laryngoscopes, tubes of different sizes)
2. **Medications**
   - Adrenaline, Naloxone, sodium bicarbonate, volume expanders.
3. **Personnel**
   - 2 persons, if a normal delivery is expected.
   - 3 persons, if a depressed infant is expected.

Anticipation: good history

Steps of resuscitation after delivery

Initial assessment: 3 questions

1. Was he borne at term?
2. Is he breathing or crying?
3. Does he have a good tone?

No
Start resuscitation

Yes
The baby should stay with his mother

Immediately after delivery: **keep warm and dry.**

1. Place the infant on the warming table.
2. Dry the infant (the head first).

A: airway
Opening and Suctioning

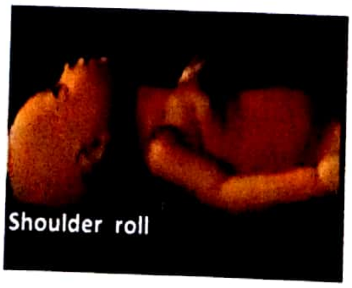
B: breathing
Stimulation and oxygen administration

C: circulation
Chest compressions

D: drugs
rarely needed

A. Airway: opening and suctioning

1. **Opening**: by proper neck position (slightly extended) a shoulder roll my help
2. **Suctioning**: suction the mouth first, then nose (avoid deep oral suction as any touch of the posterior pharynx may cause vagal stimulation leading to bradycardia and apnea).



Then at this point, start a process of evaluation, decision and intervention

- The most important items are:-
  - Respiratory effort: to be spontaneous
  - Heart rate: to be greater than 100/m
  - Color:- to be pink
- If any of these 3 signs is abnormal, take steps to correct the deficiency and reevaluate every **15-30** seconds until all signs are present and stable

B. Breathing: stimulation and positive pressure ventilation

1. Tactile stimulation

Indications: If the baby is breathing irregularly but has good activity.

Method

- Gentle slapping the sole of the foot or rubbing of the back
- It should be done in presence of free flow of oxygen and only for 10 seconds

2. Bag and mask positive pressure ventilation

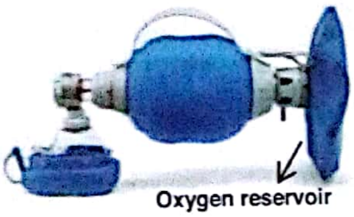
Indications

- Apnea.
- Heart rate less than 100.

Method

- Self-inflation bag (Ambu bag connected to oxygen reservoir) or flow inflating bag
- Correct size of mask (cover mouth and nose, but not eyes)
- Rate : 40 – 60 /minute

Revaluate after 15- 30 seconds, if not improving (recheck bag and mask seal, position of the baby and the presence of any mouth secretion)



3. Endotracheal intubation and positive pressure ventilation

Indications

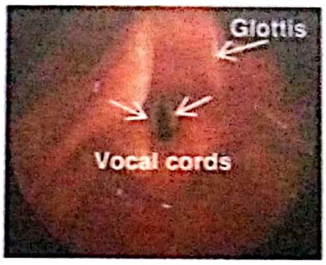
- Bag and mask ventilation is not resulting in improvement or if it exceed 5 minutes.
- Heart rate less than 60/minute
- Other indications of endotracheal intubation:
  - Suctioning of meconium.
  - Surfactant administration.
  - Suspected diaphragmatic hernia.

Method

- Proper position of the head (slightly extended neck).

- Proper tube size.
- Laryngoscope (left hand), endotracheal tube (right hand).
- Landmarks assessment: the glottis with vocal cords on either side as an inverted "V"
- Introduce the tube the right side of the mouth an insert it between the vocal cords
- Confirm equal air entry by Ambu bag and stethoscope

Revaluate after 15- 30 seconds



C. Circulation: chest compression

Indications

- Heart rate less than 60 /minute despite 30 seconds of effective positive pressure ventilation with 100% oxygen.

Methods

- Technique: 2 thumbs (hand encircling) technique or 2 finger technique.
- Rate / minute: 90 compressions to 30 ventilation (squeeze- squeeze- squeeze- puff).
- Depth: 1/3 of the anterior- posterior diameter of chest.

Revaluate after 15- 30 seconds: cardiac monitor or pulse oximeter can be used to assess heart rate, stop compression when heart rate is more than 60/minute.

D. Drugs: rarely needed, it is given IV through umbilical vein

1. **Adrenaline** : IV or through endotracheal tube
   - **Indications**: If heart rate less than 60/minute despite 30 seconds of adequate ventilation and chest compressions
   - **Action**: ↑ heart rate, force of contraction and peripheral vasoconstriction.
   - **Dose** :0.1 – 0.3 ml/kg of 1: 10,000 solution (0.5-1ml/kg for endotracheal route)
2. **Volume expander** e.g. normal saline or ringer lactate
   - **Indication**: blood loss
   - **Action**: ↑vascular volume and ↓metabolic acidosis (by improving tissue perfusion).
   - **Dose**: 10 ml/kg over 50 10 minutes.
3. **Naloxone**

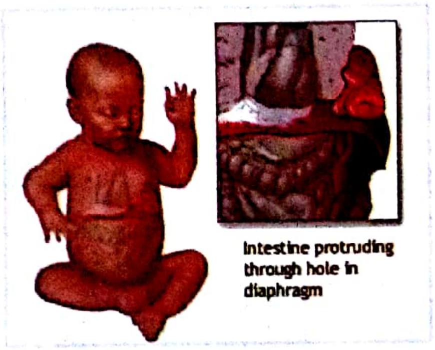
- **Indication**: respiratory depression (maternal narcotic intake within 4 hours of delivery).
- **Action**: narcotic antagonist.

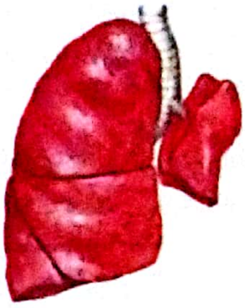
4. **Sodium bicarbonate**
   - **Indication**: prolonged cardiac arrest (it can be very harmful if given early in resuscitation)
   - **Action**: corrects acidosis and provides some volume expansion
   - **Dose**: 2-4 ml/kg of 4.2% solution very slowly in prematures (hypertonic solution may lead to intraventricular hemorrhage)

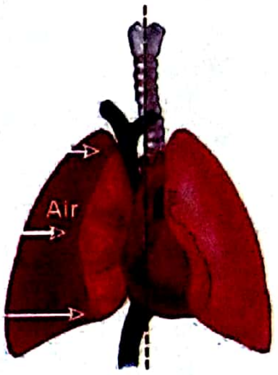
Reasons of failure of resuscitation: causes of birth asphyxia

1. Central apnea: brain insult e.g. intracranial hemorrhage or severe hypoxia.
2. Delay in the start of ventilation.
3. Airway obstruction: stenosis or laryngeal spasm or extensive secretion.
4. Lung pathology: hypoplasia – diaphragmatic hernia- pneumothorax.
5. Severe hypovolemia and shock.

N.B: Adequate ventilation is the key to successful resuscitation.







Apgar scores

Definition

Scoring system given to a newborn at:

- 1 minute to evaluate the baby condition and decide the need for resuscitation
- 5 minutes to evaluate the effect of resuscitation

Scoring items

	0	1	2
Heart rate	Absent	Less than 100/m	Over 100/m
Respiratory effort	Absent	Slow irregular	Good crying
Color	Blue	Body pink, limbs blue	All pink
Muscle tone	Limp	Some flexion (limbs)	Active motion
Reflex irritability	No response	Grimace	Cough

Interpretation

- No asphyxia: 8-10
- Mild asphyxia: 5-7
- Moderate asphyxia: 3-4
- Severe asphyxia : 0-2

Hypoxic Ischemic Encephalopathy

Definition

It is the clinical manifestation of brain injury starting immediately or up to 48 hours after asphyxia.

Etiology

1. Causes of failure of resuscitation: enumerte
2. Placental problems (insufficiency or seperation) or cord problems (e.g.prolapse)

Diagnosis

1. Persistence of an Apgar score of 0-3 for longer than 5 minutes.
2. Clinica grades

	Stage 1 : mild	Stage 2: moderate	Stage 3 :severe
Conscious level	Hyper alert	Lethargic	Stuporous
Convulsion	Absent	common	Prolonged – refractory
Tone	Normal	Hypotonic	Fluctuates between hypotonia and hypertonia
Reflex Moro	Strong	Weak	Absent No spontaneous movement
Pupils	Mydriasis	Miosis	Unequal
Feeding	Impaired feeding	Can not feed	Multi organ failure e.g. . Myocardial ischemia

Investigations: revise stabilization of sick infant: page

Laboratory: needed to exclude multi organ dysfunction that may occur with hypoxia: P

Imaging

1. EEG to detect abnormal background activity to confirm early encephalopathy
2. CT and MRI
3. Echo (cardiac dysfunction and persistent pulmonary hypertension may occur)

Treatment:

1. Proper stabilization to minimize neuronal damage: revise stabilization of sick infant :P
2. Treatment of seizures by anticonvulsants : discuss
3. Treatment of hypotension by volume and inotropic support
4. Treatment of hypoglycemia(glucose 10%) and hypocalcemia (Ca gluconate IV)
5. Therapeutic hypothermia (head cooling to a rectal temperature of 33-34 by cool cap) reduce brain damage if started within 6 hours

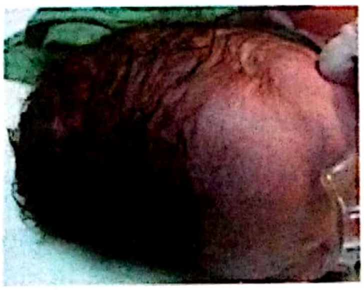
Cool cap

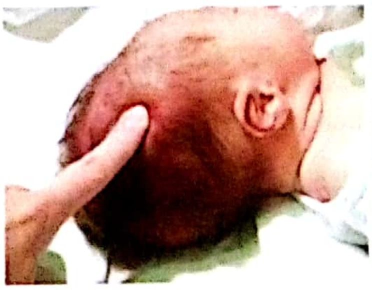
Characteristic Of Healthy Newborn

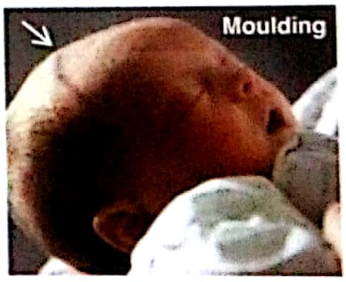
1. **Measurements**
   - **Weight**: 2.500 to 4.250 kg (average 3.500 kg).
     During the first 3-7 days the infant loses up to 10% of his birth weight and regains it by the 8th to 12th days (physiological weight loss)
   - **Length**: 46 to 56 cm (average 50 cm)
   - **Head circumference**: 33 to38 cm (average 35 cm)

2. **Vital signs**
   - **Heart rate**: 110- 160 / minute
     - Regular but variable (90/minute in sleeping babies -180 during activity).
     - Pulse is best felt on femoral artery (reduced in aortic coarctation)
   - **Respiratory rate**: 30-40 / minute : respiratory distress if more than 60/minute
   - **Blood pressure**: 70 / 50 mmHg, rising to 80/60 mmHg by the 4th day. It varies with both weight and gestational age.

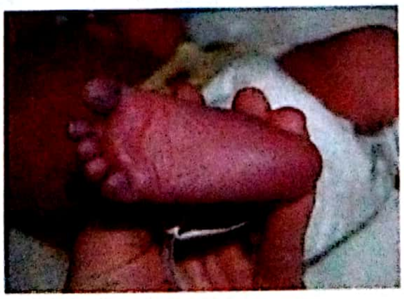
3. **Head**
   - **Fontaneles**
     - Posterior fontanel: closed
     - Anterior fontanel is opened and extremely variable in size (from 1-5 cm width)
   - **Cranial bone**
     - Craniotabes (soft cranial bones).
     - Moulding (overriding cranial bones one upon the other) may be present
   - **Caput succedaneum**
     - It is soft edema of the presenting part especially after prolonged labor.
     - It extends over the suture lines and disappears in 2days

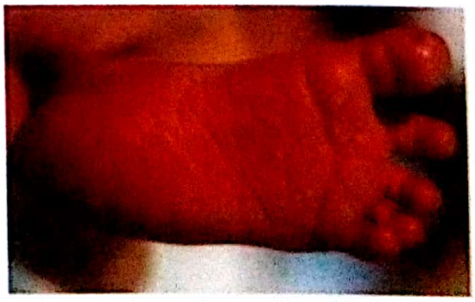






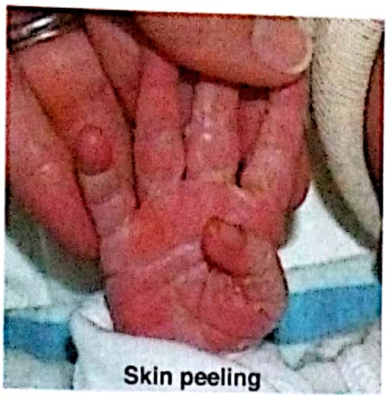
4. **Limbs**
   - **Acrocyanosis**: bluish discoloration of the hand and feet is very common in the first 24 hours especially in cold environment.
   - **Sole creases** are complete in full term babies.

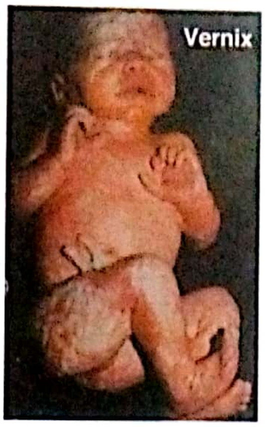




5. Skin

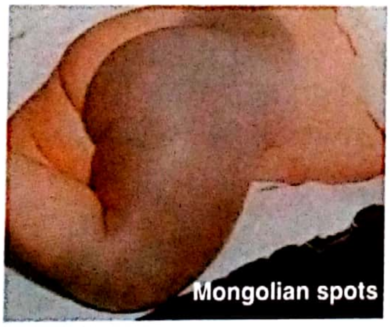
- **Color**: pale pink, deep red on crying.
- **Superficial peeling of the skin in the first week especially over the limbs**
- **Vernix caseosa:** protective greasy white layer (lipid in nature). It comes off by itself within 3-4 days (however it is usually removed after delivery)
- **Lanugo hair** : fine hair that gradually lost during the first month.

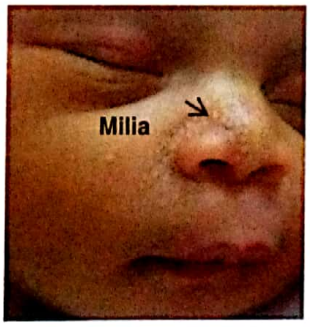

Skin peeling

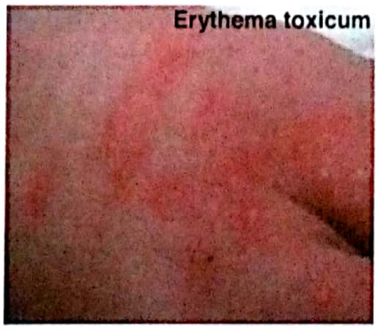

Vernix

Lanugo hair

- **Physiological jaundice (mention its features)**
- **Mongolian spots**: it is bluish discoloration on sacral area and buttocks. They fade slowly over the first few years (misdiagnosed as bruises).
- **Neonatal urticaria (erythema toxicum)** fine popular lesion with erythematous base appear at 2-3 days of age, disappear by 1 week of age
- **Milia** : plugged sweat glands on the nose , chin or forehead , disappear within the first few weeks and require no treatment

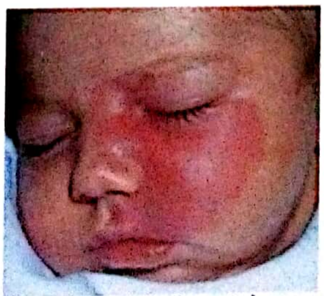

Mongolian spots

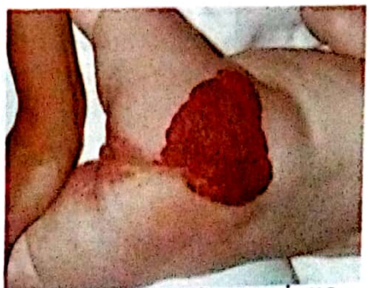

Milia


Erythema toxicum

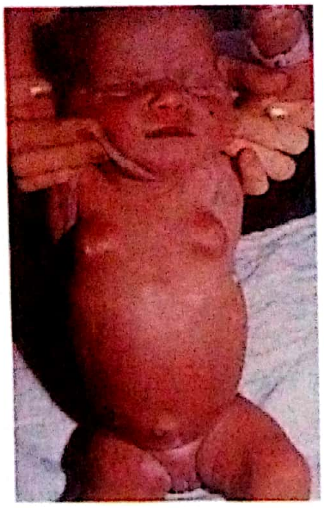
- **Vascular abnormalities**
  - **Salmon patches** **(nevus simplex):** flat pink macular found on the forehead. It resolves by 1 year of age
  - **Port wine stain (nevus flammeus):** mildly elevated reddish purple lesion on the face. Unilateral and may be associated with cortical lesion (Sturge Weber lesion)
  - **Cavernous hemangioma**: deep strawberry hemangioma→ platelets trapping. It requires : Laser, surgery or drug therapy (steroids or alpha interferon)

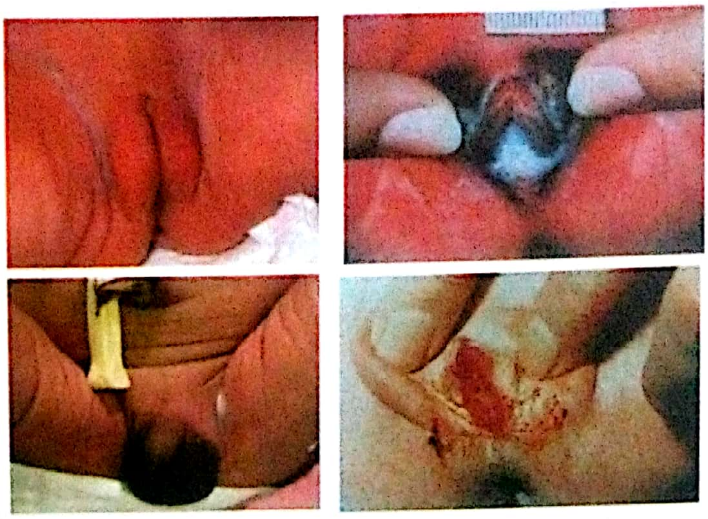
Salmon patches


Port wine stain


Cavernous hemangioma

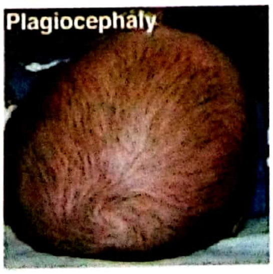
6. **Breast** enlargement both in males and females (due to trans placental passage of maternal hormones). It may persist for several weeks. It should not be squeezed.

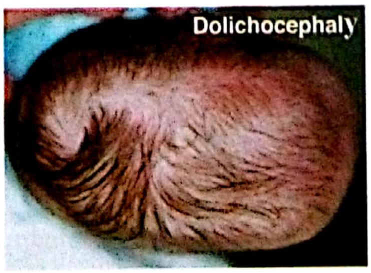




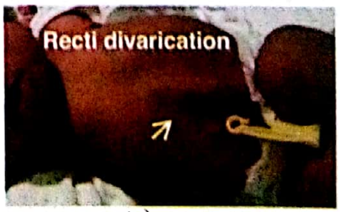
7. **Genitalia**
   - **Labia minora** is relatively larger and covered by labia majora
     Mucoid vaginal discharge is present at birth, it t may be blood tinged (endometrial bleeding). It is maximum at 3rd or 5th day and disappears within the second week.
   - **Scrotum** is relatively large, testicles are present in the scrotum

8. **Posture**
   - The posture of the infant after birth reflects his position in utero
   - If the amount of amniotic fluid is less than average→ congenital postural deformities
     - Head: Dolichocephaly and plagiocephaly (odd shape)
     - Face: mandibular asymmetry, micrognathia (receding mandible)
     - Neck: neck muscles contractures and torticollis
     - Limbs
       Dislocation of hip (common with breech presentation- female)-dislocation of shoulders
       Distorted hand or foot (Club hand and club foot)
     - Chest wall compression


Plagiocephaly


Dolichocephaly

9. **Systems examination**
   - **Heart**: apex is on the 3rd -4th space outside mid-clavicular line.
   - **Abdomen**
     - Slight distention, sometimes with recti divarication.
     - Liver is palpable 1-2 cm below costal margin.
     - Spleen tip and kidney on the left side may be palpated.
     - Umbilical stump sloughs off between 6th and tenth day


Recti divarication

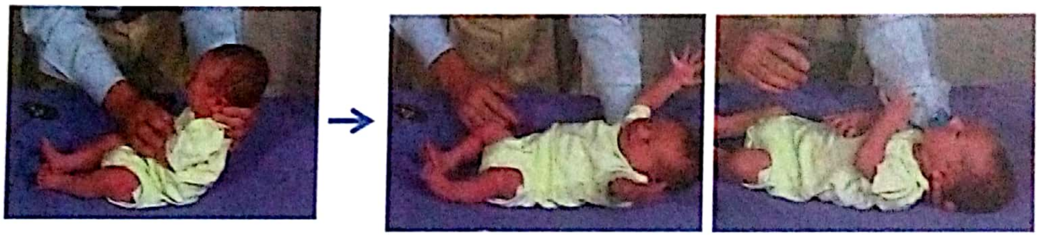
   - **Chest**: respiration is mainly abdominal (as breathing is mainly diaphragmatic).
   - **Neurological**: screening by neonatal reflexes.

Neonatal Reflexes

- These are primitive reflexes (brain stem and spinal cord centers) that if elicited normally at birth → normal CNS
- As cortical maturation proceeds, these reflexes gradually disappear at 4-6 months, because voluntary motor functions (cortical function) supersede them. Persistence of these reflexes beyond certain time → cortical damage

1. Moro reflex

- **Stimulus**
  - Dropping the head with the examiner's hand supporting the body.
  - Making a loud noise near the infant's ear.
  - Sudden withdrawal of the blankets from underneath the infant.
- **Positive response**
  - Extension (forearm), abduction (arm) and extension of the trunk. This is followed by flexion and adduction of upper limbs.
  - The hands and fingers are widely opened during the reflex. A cry follows these movements.



- **Clinical significance**
  - Normal response at birth → normal CNS.
  - Absent → serious CNS affection
    Cerebral injury by (hemorrhage or asphyxia)
    Cerebral depression by anesthetic drugs given to the mother
  - Asymmetrical response→ fracture clavicle or Erb's palsy.
  - Persistence of the reflex beyond 6 months →cerebral palsy or mental retardation.

2. Suckling reflex

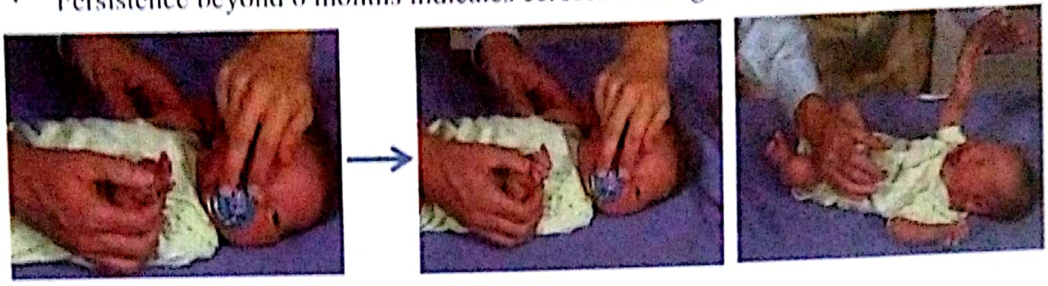
- **Stimulus:** introduce a nipple or a finger in infant's mouth.
- **Positive response:** suckling.
- **Clinical significance:** absent reflex in serious brain lesions or serious infections.

3. Rooting reflex

- **Stimulus**: touching the lips (upper or lower lip at the middle line) or the corners of the mouth.
- **Positive response**: the mouth opens or the head turns towards the side of the stimulus

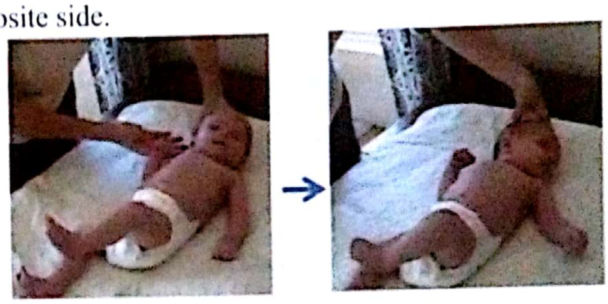
4. Grasp reflex

- **Stimulus**: placing a finger in the palm.
- **Positive response:** flexion of the fingers and gripping the examiner's finger.
- **Clinical significance**
  - Unilateral absence indicates focal neurological damage.
  - Persistence beyond 6 months indicates cerebral damage.



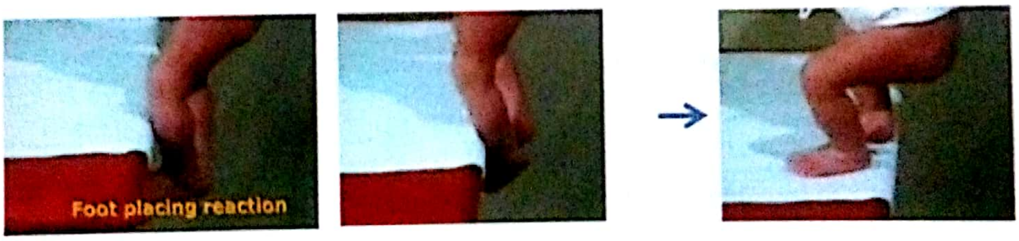
5. Tonic neck reflex

- **Stimulus**: rapid turn of the head to one side while the infant is in the supine position.
- **Positive response**
  - Extension of the arm and leg on the side towards which the head is turned.
  - Flexion of the limbs on the opposite side.
- **Clinical significance**
  - Absence: spinal cord disease
  - Abnormal response→ Cerebral neuromotor disease
  - Persistence: cerebral damage



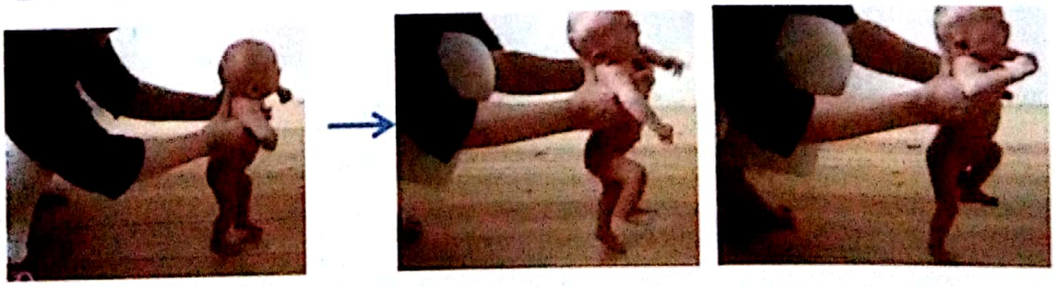
6. Placing reflex

- **Stimulus:** hold the baby with the dorsal surfaces of the foot touching the edge of the table.
- **Positive response:** The foot is elevated and placed on the table.



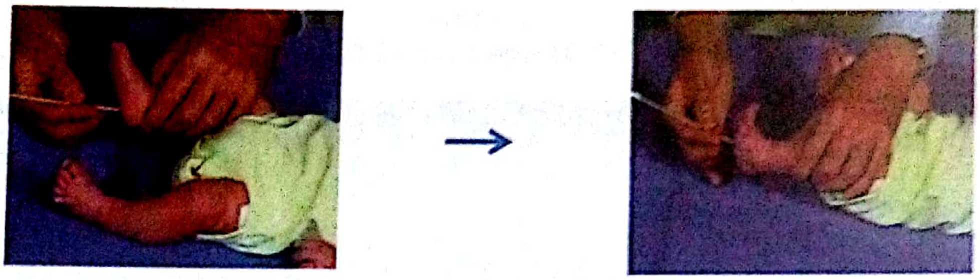
7. Stepping reflex

- **Stimulus**: hold the baby with his feet touching a table.
- **Positive response**: the baby elevates one limb and the other as if he is walking.



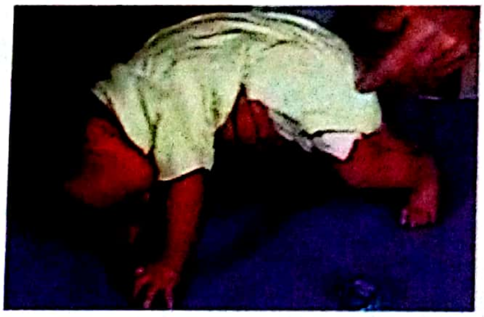
8. Babinski reflex

- **Stimulus**: scratching the outer aspect of the sole of the feet.
- **Response**: dorsiflexion (positive response).
- **Clinical significance**
  - The reflex is normal in infants up to 2 years old (usually disappear by the age of 1 year)
  - Persistence above 2 years of age → upper motor neuron disease



9. Landau reflex

- **Stimulus**: The infant is held prone in a horizontal position.
- **Positive response**: The baby forms a convex arc upwards with head, trunk and hips flexed and shoulders drawn back
- **Clinical significance**
  - It appears at 3 months, disappears at 9-12 months
  - Delayed appearance suggests mental retardation or cerebral palsy



10. Blinking and pupillary reflexes

- **Blinking reflex** :sudden exposure of the eyes to bright light → blinking
- **Pupillary reflex**: exposure to bright light leads to pupillary →constriction, while exposure to dim light → pupillary dilatation
- **Clinical significance**
  - They appear at birth and dose not disappear
  - Significance: both reflexes are important for evaluation of vision

Biochemical screening (Guthrie test) and hearing screening in neonates

Some inherited disorders have little diagnostic symptoms at birth and can be screened by simple and cheap tests; early diagnosis and therapy improve the prognosis e.g.

1. Hypothyroidism
2. Metabolic disorders: Phenylketonuria, Homocystinuria and Galactosemia the test is performed when milk feeding has been established between 3rd and 8th day of life
3. Blood disease: thalassemia and sickle cell anemia.
4. Cystic fibrosis

Classification Of Newborns

According to gestational age

Preterm
< 37 weeks<259 days

Term
37- 41 weeks: 259-293 days

Post-term
> 42 weeks >294days

According to the birth weight

Moderately Low birth weight
1501-2500 gram

Normal weight
2.501 gram or more

Large weight
More than 4 kg

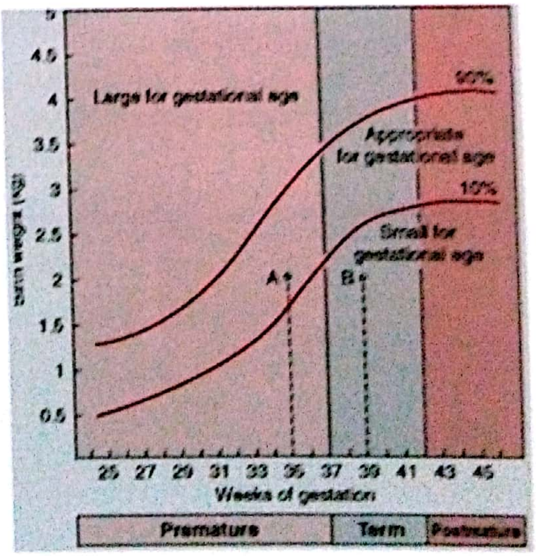
. Very low birth weight : 750 – 1500 gram
. Extremely low birth weight: less than 750 gram

According to birth weight in relation to gestational age

1- **Small for gestational age**:
Birth weight less than the 10th percentile for gestational age: B

2- **Appropriate for gestational age**
Birth weight between 10th and 90th percentile for gestational age : A

3- **Large for gestational age**
Birth weight more than 90th percentile for gestational age



Preterm Babies (prematurity)

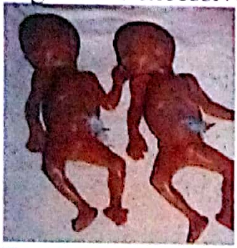
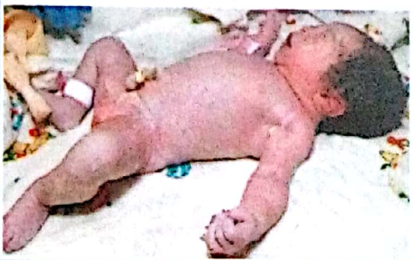
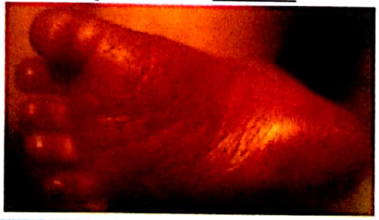
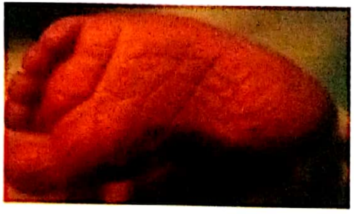
Definition

Babies born before 37 weeks of gestation.

Etiology

1. Premature rupture of membranes
2. Placental separation
3. Maternal chronic diseases.
4. Obstetric causes: incompetent cervix, bicarbonate uterus, antepartum hemorrhage

Clinical picture

	Preterm	Full term
1. **Posture**	. Frog like leg position	Flexed posture
2. **Skin**	. Color: dark red (thin, transparent) waxy appearance . Lanugo hair : excessive 	Pink Less lanugo hair 
3. **Ear**	. Ear pinna: soft, no recoil.	. Firm, immediate recoil
4. **Limbs**	. Incomplete sole creases. 	. Complete sole creases 
5. **Genitalia**	Boys : Undescended testicles Girls Labia majora is widely separated, not covering the labia minora 	Testes in scrotum Labia minora and clitoris covered by labia majora

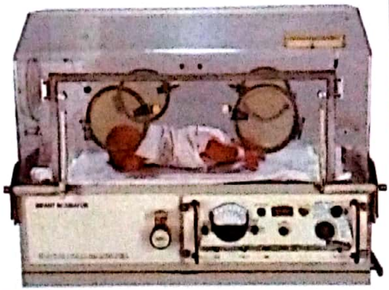
Medical problems or complications of preterm

1. **Respiratory**
   - **Respiratory distress syndrome**.
   - **Apnea**
2. **Neurological**
   - **Intracranial hemorrhage.**
   - Periventricular leukomalacia
3. **Abdominal**
   - **Necrotizing enter colitis** with intestinal perforation
   - Immature bowel function
4. **Hematological**: anemia of prematurity
5. **Sepsis:** due to immature immune system
6. **Metabolic problems**
   - Hypoglycemia, Hypocalcemia and hypomagnesemia
   - **Hypothermia**
   - Hyperbilirubinemia : prolonged physiological jaundice
7. **Nutritional**: poor suckling and swallowing reflex.
8. **Retinopathy** of prematurity

Stabilization of the preterm or sick infant

Basic life support

1. Temperature control and incubator care to avoid hypothermia
2. Correction of fluid, electrolytes and pH abnormalities.
3. Prophylactic antibiotics till culture appear.
4. Proper inotropic support if needed
5. Strict aspsis while handling the baby



Monitoring

Clinical

1. Vital signs
2. Oxygen saturation by oximeter

Lab monitoring

1. Arterial blood gas analysis
2. Hemoglobin
3. Electrolytes , calcium, glucose albumin
4. C reactive protein and ESR

N.B: Practical points in feeding premature infants

1. Nasogastric feeding is indicated in too prematures < 33 weeks
2. Trophic feeding (nonnutritive feeding): introduction of very small volumes of enteral feeding (1ml milk/6 hours) aiming at gut maturation. Indicated in extremely low birth weigh
3. Parenteral nutrition (providing nutritional requirement by IV route): in infants< 1500 gram or when oral intake is contraindicated e.g. necrotizing enterocolitis or after some surgical intervention

Small For Gestational Age

Definition

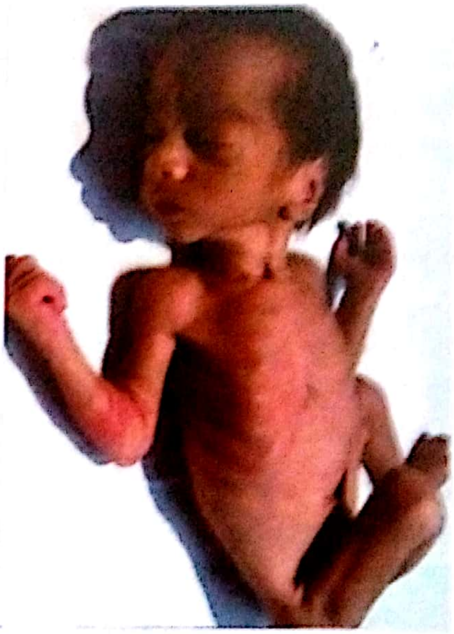
Birth weight below the 10th centile for gestational age

Etiology

1. Maternal chronic disease e.g. hypertension, heart or renal diseases.
2. Placental insufficiency e.g. pre-eclampsia, vascular malformation and placental infarction.
3. Fetal causes : Congenital infections, Congenital anomalies and Chromosomal disorders

Clinical picture

1. **Measurements : weight , length and head circumference are below the 10th centile**
   - Asymmetrical growth retardation: due to factors that affect last part of pregnancy e.g. pre-eclampsia. The weight lies on a lower centile than that of the head.
   - Symmetrical growth retardation occurs in early pregnancy e.g. congenital infections. Head circumference, length and weight may, all decreased in a proportionate way.
2. **Skin**
   - Dry, loose, thick
   - Decreased subcutaneous fat
   - Malnourished appearance
3. **Ears, breast and genitalia are mature.**
4. **Good muscle tone.**



Complications

1. **Respiratory**
   - Perinatal depression
   - Meconium aspiration.
   - Pulmonary hemorrhage.
2. **Metabolic**
   - Hypoglycemia due to poor glycogen stores.
   - Hypothermia due to loss of subcutaneous fat .
3. **Congenital infections** are common association

Large For Gestational Age

Definition

Birth weight above the 90th percentile for gestational age

Etiology

1. Constitutional
2. Infants of diabetic mother
3. Hydropes fetalis

Problems or complications

1. Birth injuries especially if born vaginally
2. Hypoglycemia
3. Complications of infants of diabetic mothers.

Infant Of Diabetic Mother

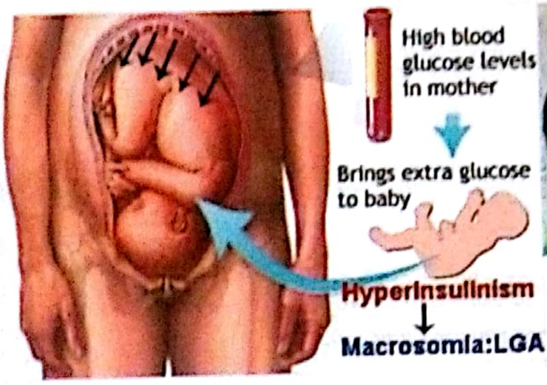
Incidence

3% to 10% of pregnancies are complicated by abnormal glycemic control

Clinical features and complications of infant of diabetic mother

Fetal problems

1. **Malformations** especially cardiac malformations and sacral agenesis.
2. **Macrosomia in 60% of infants of diabetic mothers → birth injuries**
   - Birth weight more than 95% percentile for gestational age.
   - Maternal hyperglycemia causes fetal hyperglycemia (as glucose crosses the placenta).
   - Fetal hyperglycemia → fetal hyperinsulinism which promotes growth
   - It redisposes to cephalopelvic disproportion especially if born vaginally→ birth trauma e.g. cephalhematoma, brachial plexus injury and phrenic nerve paralysis.
3. **Intrauterine growth retardation in less than < 5 % of infants of diabetic mothers.**
   - Due to advanced diabetic vascular disease → poor blood supply to the fetus.


High blood glucose levels in mother
Brings extra glucose to baby
Hyperinsulinism
Macrosomia:LGA

Neonatal problems

1. Hyaline membrane disease (Respiratory distress syndrome) due to ↓ surfactant production. Transient tachypnea of the newborn due to retained fetal lung fluids from caesarean section
2. Hypoglycemia from hyperinsulinism and sudden interruption of glucose after birth.
3. Hypocalcemia and Hypomagnesaemia in 50% of cases within 72 hours of birth.
4. Hematological: Polycythemia (20-30% of cases)
5. Hyperbilirubinemia (indirect) due to polycythemia, ineffective erythropoiesis, and relative immaturity of hepatic conjugation and excretion.
6. Hypertrophic cardiomyopathy (hypertrophy of the cardiac septum), in 30% of cases, it regress over weeks. 10% may have frank heart failure
7. Hypoxic ischemic encephalopathy, other CNS manifestations (seizures ,lethargy)that may occur due to, metabolic disturbances, polycythemia and birth injuries
8. Higher risk for delayed motor and cognitive development that may manifest later in life

Investigations

1. Laboratory: Hematocrit, blood glucose, calcium and magnesium.
2. Imaging: Chest X ray, Echocardiography, abdominal ultrasound.

Management

1. **Delivery** should be in a hospital where the newborn can be carefully monitored
2. **After birth**: monitoring for metabolic disturbances especially hypoglycemia
    - Blood glucose should be done within 30 minutes of delivery, then at least 3 hourly for the first 48 hours postnatal
    - Asymptomatic infants(if clinically well and normoglycemic) should start early feeding.
    - If the infant is unable to tolerate oral feeding , glucose should be given by peripheral IV infusion at rate of 6-8 mg/kg/minute
3. **Careful monitoring** of complications → NICU admission for, unstable baby

Neonatal Metabolic Disturbances

Hypoglycemia

Definition:blood glucose ≤ 40 mg/dl in the first 72 hours of life (regardless of the gestational age)

Etiology

1. Infant of diabetic
2. Intrauterine growth retardation (decreased glycogen stores) and
3. Prematurity.
4. Serious illness: asphyxia, sepsis and shock.
5. Inborn errors of metabolism.

Clinical picture

1. Jitteriness, apathy, respiratory distress, convulsions, cyanosis and apnea
2. May be asymptomatic.

Treatment

1. Asymptomatic (no convulsions): glucose 10 % 2 ml/kg/ IV and early feeding.
2. Symptomatic with convulsion: glucose 10 % 4 ml/kg/ IV
3. Maintenance with IV drip of 10% dextrose 8 mg/kg/ minute IV.

Hypocalcemia

Definition: Serum Ca less than 7 mg/dl

Etiology

1. Early (first 3 days of life)
    - Infant of diabetic mother
    - Intrauterine growth retardation and Prematurity
    - Asphyxia
2. Late (after the first 3 days)
    - High phosphate load due to cow milk feeding.
    - Hypoparathyroidism.

Clinical picture

Irritability, hyperreflexia, convulsions , cyanosis and apnea.

Treatment

1. Early onset hypocalcemia with calcium level < 6.5 mg/dl: IV infusion of calcium gluconate 10%, 5 ml/kg/day
2. Convulsions, apnea with calcium level < 5mg/dl : IV Ca gluconate 10 % 2 ml /kg slowly over 5 minutes.

Hypomagnesemia

Definition: serum Mg less than 1.5 mg/dl

Etiology

1. Insufficient stores.
2. Iatrogenic (exchange transfusion)
3. Infant of diabetic mother
4. Idiopathic with hypocalcemia

Clinical picture: similar to hypocalcemia.

Treatment I.M (not IV) magnesium sulfate 50 %, 0.25 ml/kg/day.

Hypothermia (cold injury)

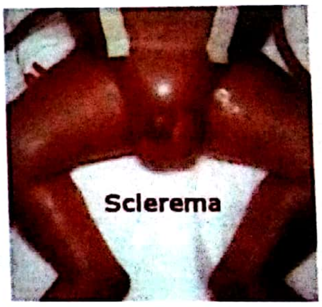
Definition: lowering of body temperature below **35.5 C°**

Etiology

1. More common in premature infant due to
   - Large surface area relative to their mass.
   - Decreased subcutaneous fat for insulation.
   - Immature heat regulatory center.
2. Inadequate drying, clothing or warming.
3. Sepsis.

Clinical picture: hypothermia →increased energy consumption → hypoxia and hypoglycemia

1. Initial signs
   - Weak suckling- lethargy- weak cry-tachycardia-tachypnea
   - Immobility, edema and redness of the extremities especially the hands, feet and face. The facial erythema gives a false impression of health and delay diagnosis
2. Late signs
   - Scleroderma (local hardening over areas of edema)
   - Hemorrhagic manifestations e.g. pulmonary hemorrhage
   - Hypoglycemia and acidosis



Treatment

1. Gradual warming
2. Correction of abnormalities e.g. hypoglycemia and hypotension

Hyperthermia

Definition: elevation of body temperature to 38-39 C° in the 2nd or 3rd day of life.

Etiology

1. High environmental temperature
2. Dehydration fever
3. Neonatal infections.

Clinical Picture

1. Skin: warm, flushed or pink initially, then pale later.
2. For cases not due to infections, the baby looks active (the reverse in infection cause)
3. Loss of weight, low urine output and depressed fontanel
4. Death in neglected cases.

Treatment

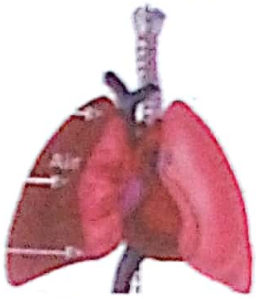
Lower the environmental temperature and give oral or parenteral fluids

Neonatal Respiratory Distress

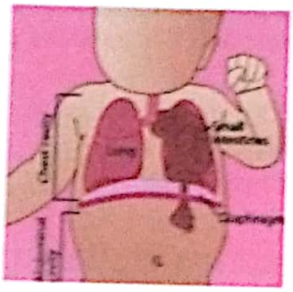
Etiology (Pulmonary and extra pulmonary causes)

Pulmonary

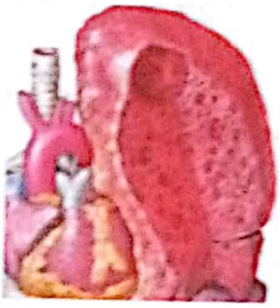
1. Respiratory distress syndrome RDS: the commonest in preterm: less common in full term.
2. Transient tachypnea of newborn TTN: the commonest in full term.
3. Meconium aspiration syndrome.
4. Pneumonia (intrauterine-aspiration of milk or secretion)
5. Pulmonary air leak: pneumothorax -pneumomediastinum- pneumopericardium-pulmonary interstitial emphysema
6. Bronchopulmonary dysplasia (lung damage in premature infants from mechanical ventilation and oxygen toxicity)
7. Pulmonary hemorrhage.
8. Congenital lobar emphysema.
9. Congenital diaphragmatic hernia.



Pneumothorax



Congenital diaphragmatic hernia



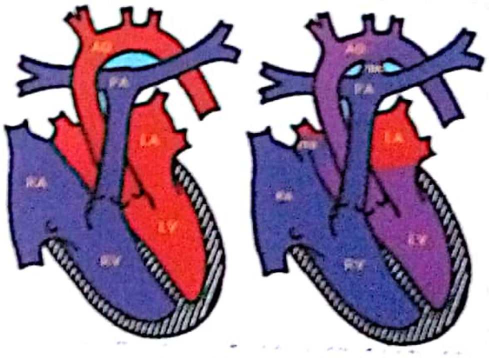
Congenital lobar emphysema

Extra pulmonary

1. **Airway: rare**
   - Choanal atresia (bilateral).
   - Laryngomalacia.
   - Tracheo-esophageal fistula.
   - Pierre-Robin syndrome
2. **Chest wall: rare**
   - Neonatal myasthenia.
   - Thoracic dystrophy
3. **Cardiac**
   - Congenital heart disease with heart failure.
   - Persistent fetal circulation
4. **Central** (cerebral irritation)
   - Cerebral Hypoxia (encephalopathy).
   - Intracranial Hemorrhage (birth trauma).
   - Drugs : narcotics
5. **Metabolic**
   - Hypothermia
   - Hyperthermia.
   - Hypoglycemia.
   - Acidosis.

Laryngomalacia

Pierre-Robin syndrome
Micrognathia
Glossoptosis



Persistent fetal circulation

Respiratory Distress Syndrome (Hyaline Membrane Disease)

Etiology

The primary cause is inadequate pulmonary surfactant

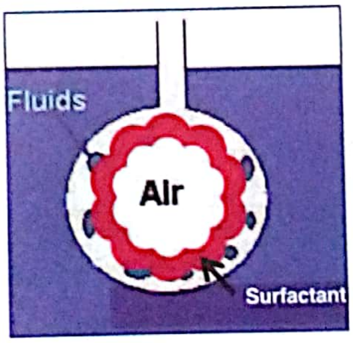
1. **Chemistry:** lipoproteins mainly phosphatidyl choline(lecithin), phosphatidyl glycerol and phosphatidyl inositol
2. **Production**
   - Type II pneumocytes
   - It is produced from 22-24 weeks gestation at first by a pathway, which is extremely sensitive to changes in temperature and pH.
   - By the end of 35 weeks gestation, mature surfactant is produced by a second pathway, which is more resistant to alterations of pH and hypoxia
3. **Function**: decreases alveolar surface tension preventing alveolar collapse in expiration
4. **Factors affecting surfactant production:** Risk factors for **R**espiratory **D**istress **S**yndrome

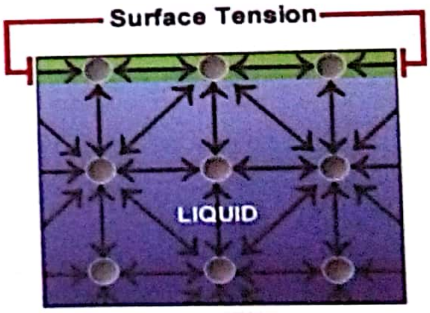
Surfactant production is delayed in: - (factors increase the risk of RD)

- Prematurity: the most important. The more the preterm, the higher the incidence of RDS
- Infants of diabetic mothers
- Infants who are the smaller of twins.
- Infants born by Caesarean section.
- Erytheroblastosis fetalis.

Surfactant production is accelerated in: - (factors decrease the risk of RDS)

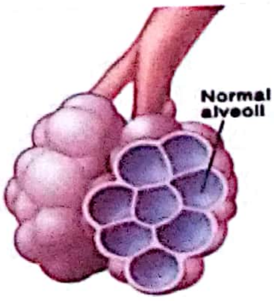
- Premature rupture of membranes greater than 48 hours.
- Pre-eclampsia and other hypertensive states
- Prenatal steroids or thyroid hormone therapy for 48 hours prior to delivery.

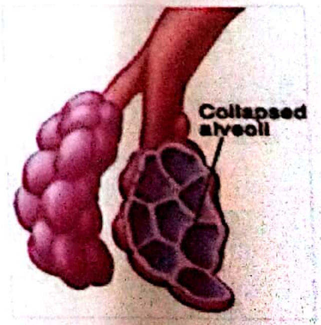




Pathophysiology: effect of surfactant deficiency

1. Increases surface tension of the alveoli (decreases lung compliance) →alveolar collapse
2. Hypoxia (due to ventilation perfusion mismatch) → acidosis
   - Pulmonary vasoconstriction and pulmonary hypertension
   - Reduces myocardial contractility→ hypotension



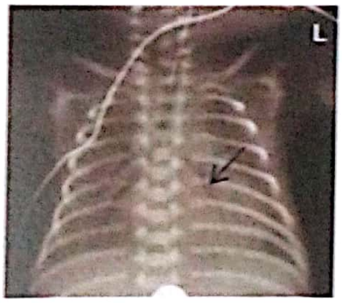


Clinical picture

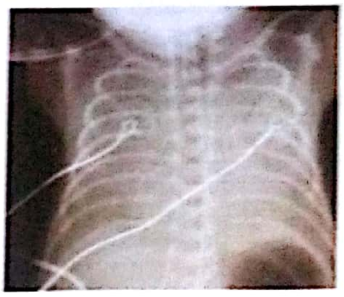
1. Severe progressive respiratory distress at delivery or within the first few hours after birth.
2. Inspection and palpation
   - Grade I Tachypnea (above 60/minute) and working ala nasai.
   - Grade II Intercostal and subcostal retractions.
   - Grade III Expiratory grunting.
   - Grade VI Cyanosis or altered consciousness in advanced cases.
3. Auscultation: diminished air entry

Investigations

1. **Chest X ray**
   - Diffuse reticulogranular pattern with air bronchogram (air in the major bronchi appears in contrast with the white background of collapsed alveoli as air bronchogram).
   - Complete opacification of both lung fields (white lung) in severe conditions.
2. **Blood gasses , electrolytes , calcium and glucose**
3. **Other investigations** : blood picture , C reactive protein and ESR



Air bronchogram



White lung

Treatment

Aim: life support till adequate amount of surfactant is formed about 36-48 hours after birth:-

Items

1. **Basic life support measures : P 296**
2. **Monitoring: P 296**
3. **Correction of hypoxemia**
   - Nasal continuous positive air way pressure (CPAP)
     If PO2 less than 50 mmHg in 60% oxygen
   - Intermittent positive pressure ventilation (IPPV) if:
     P O_2 less than 50 mm Hg in 100% O_2 or
     P O_2 less than 50 mm Hg in CPAP of 6-8 H_2O
     P CO_2 more than 70 mm Hg
   - High frequency ventilation in cases of risk of air leak
     (Respiratory rate between 300-600/minute)

4. **Surfactant replacement therapy**
   - Natural or synthetic surfactant.
   - It is given to severe cases via an endotracheal tube.
   - It markedly reduces the mortality of preterm infants with respiratory distress syndrome.

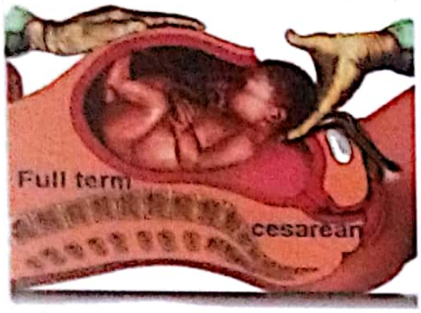
Transient Tachypnea Of Newborn

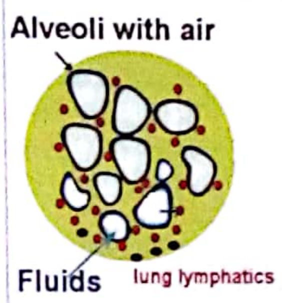
Incidence

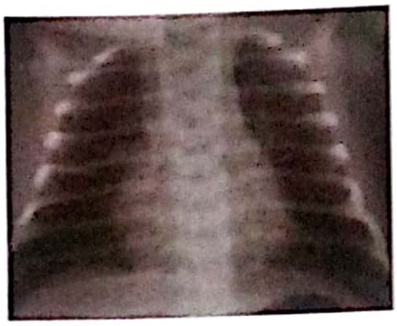
Full term or near term infants

Etiology

Delayed clearance of lung fluid after birth.







Clinical picture

1. Mild respiratory distress: tachypnea and minimal retractions (may be cyanosis severe cases)
2. Self-limited: improvement usually occurs after 24-48 hours.
3. Diagnosis is made after consideration and exclusion of other causes of respiratory distress.

Investigations

1. X ray
    - Prominent pulmonary perihilar markings (dilated lung lymphatic).
    - Fluid in the interloper fissures and small pleural effusion may be seen
2. Other investigations : **Page : 296**

Treatment

1. Basic life supports and Monitoring : enumerate P **296**
2. Proper oxygenation and IV fluids, then tube feeding until respiratory rate has decreased enough to allow oral feeding

Neonatal Pneumonia

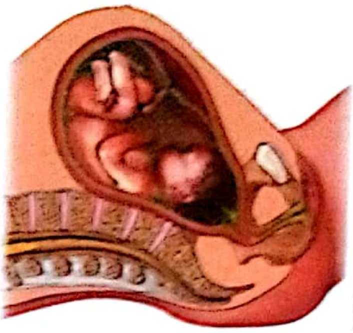
Types and pathogenesis

1. Tue congenital pneumonia: acquired in utero
2. Intra partum pneumonia: acquired during passage through birth canal
3. Postnatal pneumonia: acquired immediately after birth

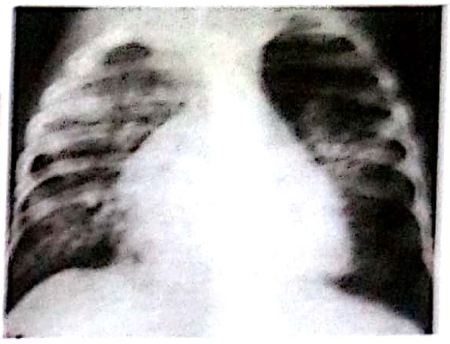
Etiology

1. Organism
    - Bacteria
        - Gram negative: E coli, Klebsiella and pseudomonas
        - Gram positive: Staph aureus or epidemidis, B beta hemolytic streptococci and listeria
        - Chlamydia.
    - Nonbacterial: CMV, Toxoplasmosis
2. Route
    - Ascending transmission, from aspiration of infected or contaminated maternal fluids
    - Hematogenous

3. **Risk factors**
   - Prolonged rupture of membranes
   - Prematurity
   - Chorioamnionitis
   - Meconium stained amniotic fluids
   - Fetal asphyxia
   - Haphazard use of broad spectrum antibiotics in obstetric ward and in NICUs



Ascending infection



Clinical picture: Respiratory distress in the first few hours after birth.

Investigation: X-ray:-patchy opacity

Treatment: Broad spectrum antibiotics until culture and sensitivity appear.

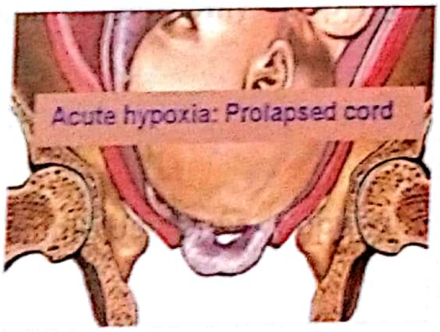
Meconium aspiration syndrome

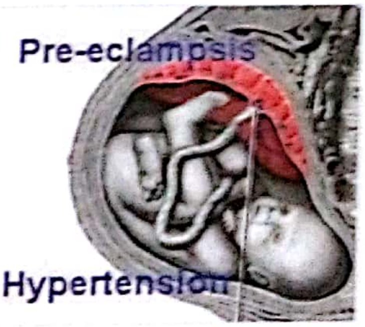
Etiology

Acute or chronic hypoxia→ passage of meconium in utero, gasping in utero or more common with the first breath →aspiration of amniotic fluid contaminated by meconium.

Risk factors: factors that cause intrauterine fetal stress

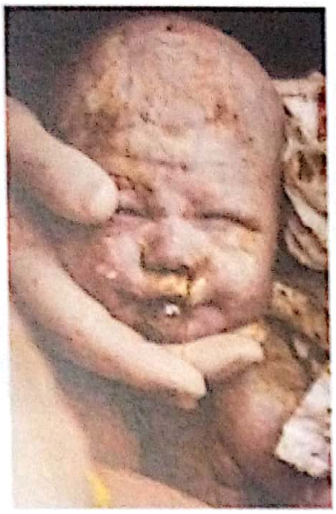
1. Post term (placental aging)
2. Acute hypoxia: complicated delivery or prolonged labor
3. Chronic hypoxia: placental insufficiency causes e.g. diabetic or hypertensive mothers

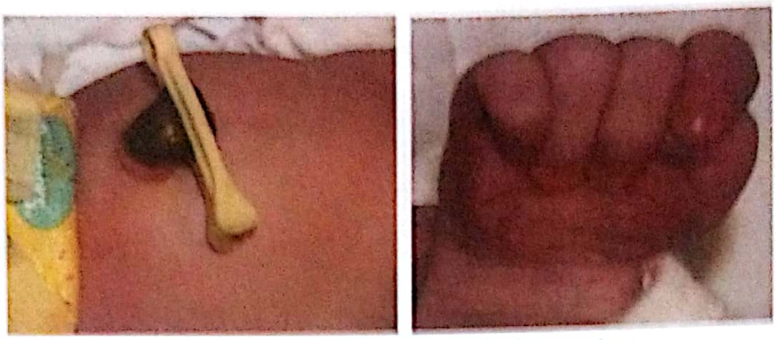




Clinical picture

1. Progressive respiratory distress (mention grades) that may be evident since birth.
2. Skin, nails and umbilical cord may be meconium stained.
3. Hyperinflated chest
4. Auscultation : coarse crepitations

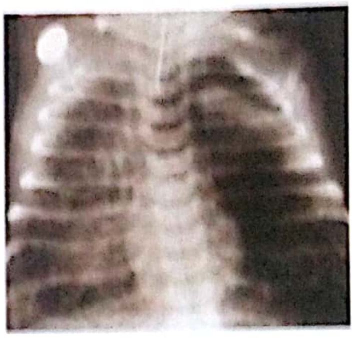




Cord and nail stained with meconium

Investigations

1. X ray: areas of lung collapse and areas of hyperinflation (Ball and valve effect of meconium allowing air in but not out)
2. Other investigations : P 296



Complications

1. Obstruction of air passages by meconium → collapse or emphysema
2. Pneumonia (Chemical pneumonitis and - secondary bacterial infections)
3. Pneumothorax and pneumomediastinum.
4. Pulmonary hypertension
5. Hypoxic ischemic encephalopathy

Treatment

1. Proper suctioning of meconium from upper airways with large pore suction catheter.
2. If meconium is seen around the larynx, or in cases with thick particulate meconium: The baby should be intubated and suction applied to the endotracheal tube with large bore suction catheter.

3. Basic life support and monitoring: P 296
4. Correction of hypoxia: P 303

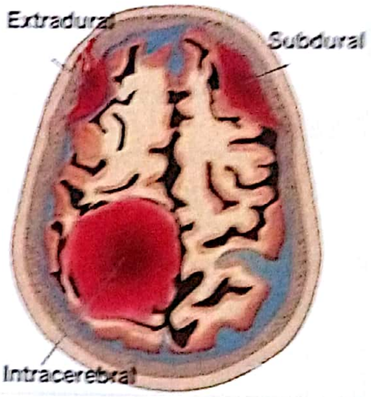
Neonatal Seizures (convulsions)

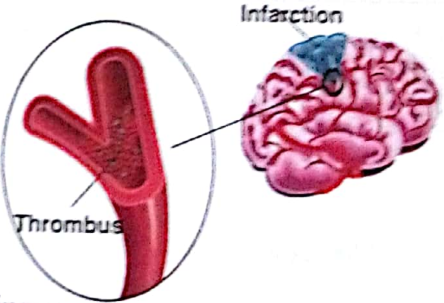
Definition

Paroxysmal disorder in brain function characterized by abnormal excessive neuronal activity., it should be viewed as a symptom of underlying significant pathological process.

Etiology: HH MM CC DD HH

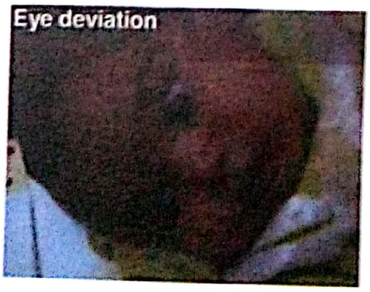
1. **H**ypoxic ischemic encephalopathy: the most common cause.
   Neonatal encephalopathy: term used to describe cerebral dysfunction in neonate when the etiology is not known
2. Intracranial **H**emorrhage: intraventricular, subdural, epidural.
3. **M**eningitis, septicemia and TORCH infections.
4. **M**etabolic
   - Hypoglycemia, hypocalcemia, and hypomagnesemia.
   - Hyponatremia or hypernatremia,
   - Pyridoxine dependency
   - Inborn errors of metabolism
5. Cerebral infarcts (venous or arterial occlusion)
   - Protein C or protein S deficiency
   - Maternal lupus
6. Cerebral contusion.
7. Developmental anomalies
   - Cerebral dysgenesis
   - Neurocutaneous syndromes e.g. tuberous sclerosis
8. Drugs
   - Maternal (narcotic withdrawal- maternal local anesthetics)
   - Neonatal (theophylline, antihistaminics, steroids)
9. Hypertensive encephalopathy.
10. Hypervisocity/ polycythemia.
11. Unknown cause : 3- 20%

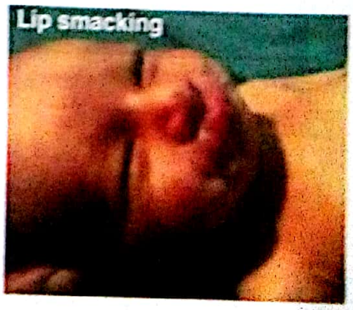




Clinical presentations

1. Subtle or fragmentary: the most common pattern
   - Eye signs: staring, deviation, blinking
   - Buccal -oral lingual: chewing, sucking., lip smacking
   - Limbs: cycling, swimming, rowing
   - Systemic: apnea, blood pressure alterations
2. Tonic: sustained posturing of the limbs or trunk or deviation of the head.
3. Clonic: repeated jerking 1-4 times/second in one limb or one side of the body
4. Myoclonic: rapid isolated jerking of muscles.





Differential diagnosis

1. **From jitteriness (benign tremors)**
   - Symmetrical rapid movements of the hands and feet.
   - Stimulus sensitive: may be initiated by sudden movements or noise
   - No associated eye movements
2. **Benign neonatal sleep myoclonus**
   - Bilateral or unilateral jerking during active sleep
   - Not stimulus related
   - Commonly involves the upper trunk more than lower trunk

Investigations

Laboratory

1. Blood picture, differential count and platelet count- hematocrit
2. Blood culture, CRP, ESR
3. Blood chemistry: glucose, calcium, magnesium, electrolytes and blood gases.
4. CSF analysis and culture.
5. TORCH screening and metabolic screen e.g. ammonia level and amino acids in urine.

Imaging

1. Cranial ultrasonography to show hemorrhage or malformation.
2. CT scan for hypoxic ischemic encephalopathy, hemorrhage and malformations.
3. MRI: cerebral ischemic lesions or cerebral malformations.
4. EEG : (normal in one third of case).If seizures are difficult to control and or require the use of multiple anticonvulsants, EEG may assist determining the cause and guide the treatment

Management

1. **Immediate management**

   A: Airway opening.

   B: Breathing: oxygen therapy to correct hypoxia.

   C: Circulation: IV line and give Ringer's lactate or saline.
2. **Correction of the cause: hypoglycemia or hypocalcemia.**
3. **Control of convulsions with anticonvulsants:** one or more drug: if seizures prolonged more than 3 minutes, frequent or associated with bradycardia or hypoxia

	Loading	**Maintenance**
Phenobarbitone	20 mg/kg IV over 30 minutes or IM	2.5 to 5 mg/kg 12 hourly starting 24 hours after the loading
Phenytoin	15-20 mg/kg IV over at least 30 minutes	4-5 mg/kg/dose 12 hourly starting 24 hours after the loading
Clonazepam	0.1 to 0.25 mg/kg	0.01 mg/kg/dose 8 hourly, starting 8 hours after the loading
Paraldehyde	0. 3 ml/kg/dose PR (preferred) 0.2 ml/kg IV or IM if the rectal route is not available	0.3 ml/kg/dose PR 4 to 8 hourly 0.1 ml/kg/dose IM or IV 4-6 hourly
Pyridoxine	100 mg IV or IM	50mg daily

Prognosis

1. Death in 15% of neonatal seizures
2. Neurological sequelae (mental deficits, motor deficits) in 30%
3. Chronic seizures disorders in 15-20 % of survivors
4. Normal outcome in the remaining survivors

Neonatal Apnea

Definition

Cessation of respiration

- For more than 20 seconds or
- Associated with bradycardia (heart rate less than 100) or
- Associated with cyanosis.

Incidence

- 25% of neonates ≤ 34 weeks gestation age have at least 1 apneic spell
- Almost all prematures ≤ 28 weeks have apnea

Etiology: P HH MMM SS

1. Prematurity: the most important.
2. **H**ypoxia: hypoxic ischemic encephalopathy , RDS
3. **H**emorrhage (intracranial hemorrhage)
4. **M**etabolic disturbances e.g. hypoglycemia, hypocalcemia, hypothermia and hyperthermia.
5. **M**eningitis, septicemia and TORCH infections
6. **M**aternal drugs e.g. magnesium sulfate
7. Gastroesophageal reflux – aspiration
8. Suction or endotracheal tube insertion
9. Seizures

Premature

Suction

Gastroesophageal reflux

Pathogenesis

1. Central apnea: immaturity of brain stem centers
2. Obstructive apnea; excessive secretion in the airways, excessive neck flexion
3. Mixed apnea

Presentation

1. **Onset** of apnea of prematurity
   - 25% at first or second days of life
   - If it doesn't occur till 7 days of age , it is unlikely to occur
2. **Offset**
   - Apnea of prematurity usually stops when the baby reaches 37 weeks of gestations, however in premature baby less than 28 weeks apnea may persist beyond them
   - Apneic spells in full term infant is always abnormal → search for a cause

Investigations: enumerate investigations of neonatal convulsions: Page 308

Management

Monitoring

1. All newborn less than 34 weeks gestational age or less than 1800 grams birth weight, should be monitored for both apnea and bradycardia
2. By bed side respiratory and heart rate monitor→ alarm if respiration sop for more than 20 seconds, or the heart rate drops below 100 beat/minute (in obstructive apnea, no apnea alarm sounds because the chest wall is moving through air flow is absent , bradycardia is the only sign)

Treatment of acute apneic episodes

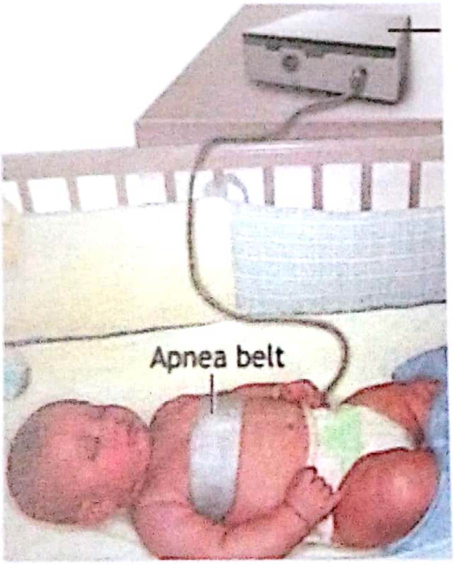
1. Physical stimulation (tactile stimulation)
2. If no response →bag and mask ventilation, suctioning and neck positioning may be needed)

Treatment of chronic or recurrent apneic episodes of prematurity

1. **Correction of any cause** e.g. hypothermia
2. **Drugs**

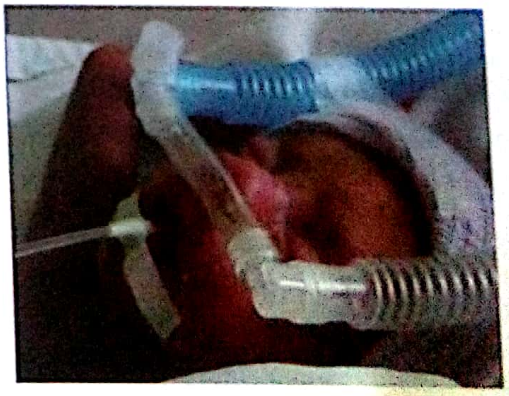
   Caffeine citrate: longer half-life and less toxic
   - Loading: 20 mg/kg/dose IV drip over 30m minutes or orally
   - Maintenance: 5mg/kg/day once a day

   Theophylline
   - Loading dose: 6 mg/kg/dose IV drip over 30m minutes or orally
   - Maintenance dose: 6mg/kg/day divided every 8 hours, orally or IV
3. **CPAP : continuous positive airway pressure (nasal or by endotracheal tube)**
   - Effective in treating both obstructive and mixed apnea but not central apnea
   - Start with CPAP level of 5 cm H_2O, , then adjust according to clinical response.
4. **Intermittent mandatory ventilation: IMV**
   - If pharmacological therapy and CPAP failed to control the apneic attacks.
   - Adjust the clinical sitting so that to prevent barotrauma: short inspiratory times with minimal peak inspiratory and expiratory pressures
   - The infant may need to remain on a minimal rate for few weeks till respiratory control system matures



Bed side apnea monitor

Stimulation



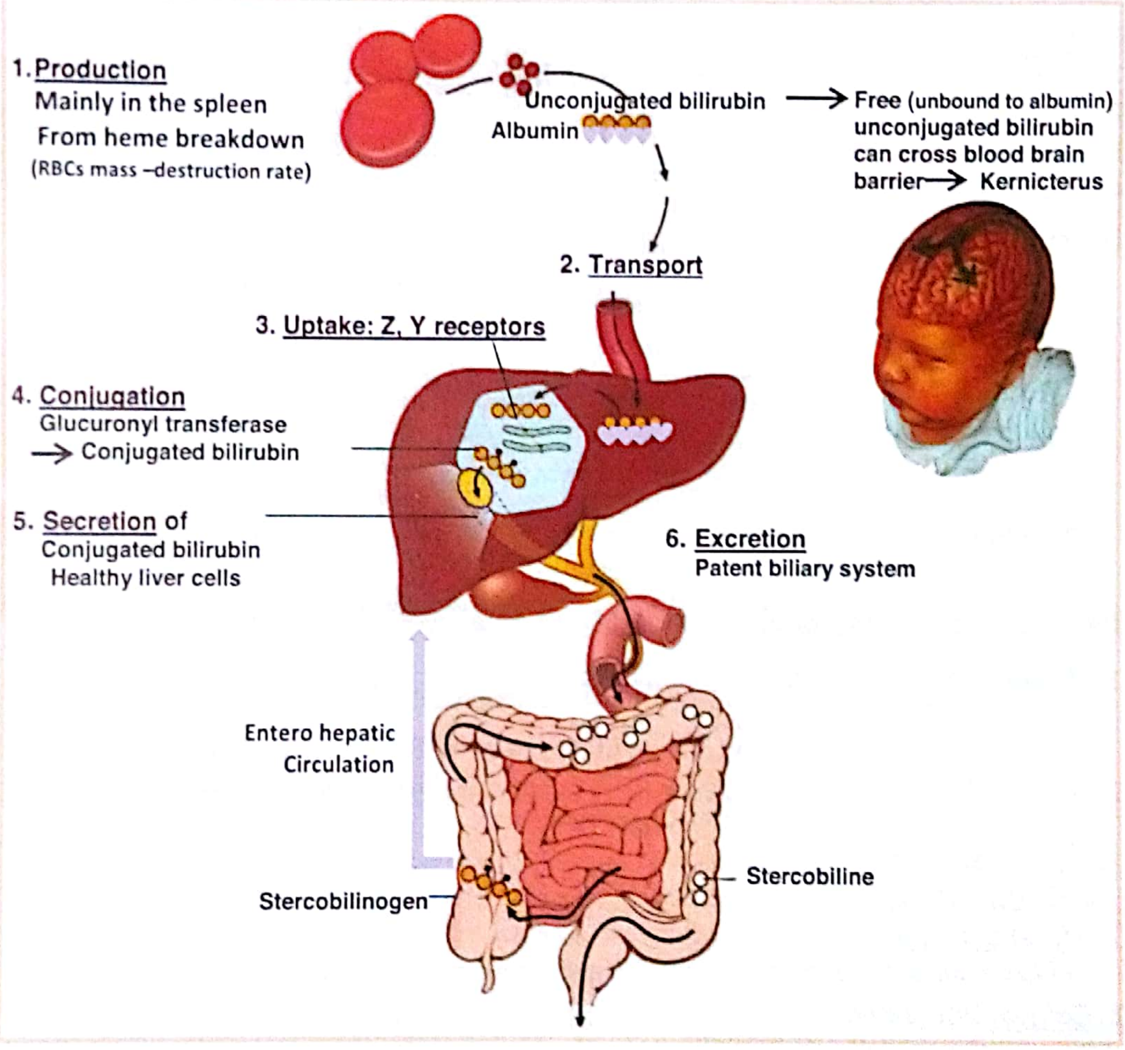
Nasal CPAP

Neonatal Hyperbilirubinemia

Definition

Yellowish discoloration of the skin and mucous membranes due to increased serum bilirubin level above normal (normal serum bilirubin is 1 mg/dl).Neonate appear jaundiced at serum Bilirubin 7 mg/dl.

Bilirubin metabolism: 6 steps



N.B

1. Each 1 gram hemoglobin gives 35 mg unconjugated bilirubin. Normal term infant break down 0.5 gm hemoglobin/day.
2. The newborn gut contain beta glucuronidaze enzyme, which hydrolyses conjugated bilirubin into unconjugated. Unconjugated bilirubin is absorbed back into enterohepatic circulation.

Etiology

Physiological
- Unconjugted

Pathological
- Unconjugated or
- Conjugated

Physiological hyperbilirubinemia

Incidence

60 % in full- term and 80 % of preterm babies. The most common cause of neonatal jaundice

Etiology

1. **Production**: increased due to increased RBCs volume and decreased red cell life span
2. **Uptake**: deceased level of Y proteins.
3. **Conjugation**: decrease activity of Glucuronyl transferase enzyme.
4. **Increased enterohepatic circulation**.

Differentiation between physiological and pathological jaundice

	Physiological	Pathological
- Onset	2nd or 3rd day	First 24 hours
- Rate of rise	Less than 5 mg%/day	More than 5 mg%/day
- Peak in full term	Less than 15 mg%	More than 15 mg%
- Type	Always unconjugated	Conjugated or unconjugated
- Duration	1 week (in full term baby)	More than 2 weeks

Pathological unconjugated hyperbilirubinemia

1. **Production:** overproduction of bilirubin
   - ↑ Rate of RBCs destruction:
     - Isoimmune Hemolytic disease of the newborn: Rh and ABO incompatibility.
     - Hemolytic anemia: spherocytosis (autosomal dominant), G6PD (X linked recessive)
     - Extravasated blood: large cephalhematoma.
     - Septicemia.
   - ↑ Mass of RBCs: polycythemia.
2. **Uptake defect** Y and Z protein
   - Gilbert disease: deficiency of Y and Z proteins.
3. **Conjugation defect** Glucuronyl transferase enzyme
   - Congenitally absent enzyme: Crigler Najjar syndrome.
   - Unstimulated enzyme: prolonged hyperbilirubinemia in cretinism.
   - Inhibited enzyme: breast milk jaundice.
4. **Increased enteorhepatic circulation**
   - Pyloric stenosis, intestinal obstruction e.g. ileal atresia
   - Breast feeding jaundice

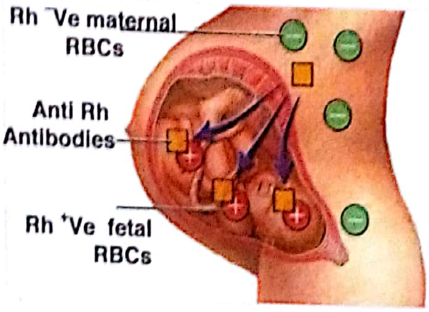
Pathological conjugated hyperbilirubinemia: cholestasis (see hepatology)

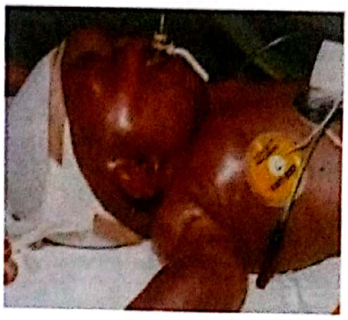
Discussion on the most important causes

Isoimmune Hemolytic disease due to Rh incompatibility

Pathogenesis

1. Sensitization of Rh -Ve mother through:
   - Rh +Ve fetal blood enter the maternal circulation during pregnancy, abortion or delivery.
   - Transfusion of Rh +Ve blood.
2. Anti Rh antibodies are formed (IgG) that cross the placenta causing hemolysis of fetal RBCs. This usually occurs:
   - During the first pregnancy if sensitization occurred by mismatched blood transfusion or previous abortion.
   - In the subsequent pregnancies if sensitization occurs by the first pregnancy.





Clinical Picture: variable

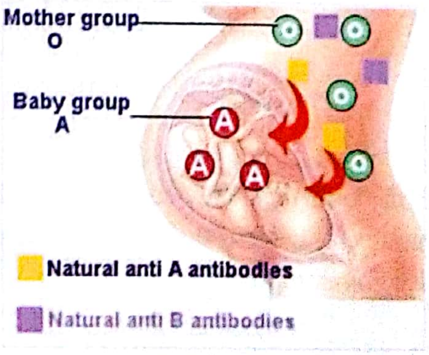
1. Mild form: only laboratory evidence of mild hemolysis (15%)
2. Moderate: variable degree of anemia and jaundice
3. Severest form (Hydropes fetalis) marked anemia in the fetus or neonates → anemic heart failure →
   - Respiratory distress.
   - Generalized edema usually with pleural effusion and pericardial effusion.
   - Death in utero or shortly after birth

Prevention

Anti D antibodies given IM to the mother within 72hours of delivery (or abortion)

Isoimmune Hemolytic disease due to ABO incompatibility

1. More common but milder (rare kernicterus) than Rh incompatibility.
2. Seen only in A or B infants born to O group mother who have the natural anti A and anti B antibodies of the IgG class, which cross the placenta→ hemolysis of the baby RBCs during pregnancy or after delivery.
3. It may be seen in the first born infant because the maternal antibodies are natural.



- **Breast milk jaundice**: jaundice is more common and prolonged in breast fed infant

1. **Breast milk jaundice**
   - Mild form occurring in 3 % of breast fed infants.
   - It may be due to maternal hormones present in breast milk that compete with bilirubin for Glucuronyl transferase enzyme.
   - Bilirubin levels continue to rise after 4th day instead of decreasing may reach 20 mg /dl by 14th day.
   - If breastfeeding is continued , the levels will return very slowly to normal by 4-12 weeks
   - Stopping breast milk for 2 days leads to rapid fall in serum bilirubin within 48 hours. On continuation of breast milk ,bilirubin levels increase slightly.

2. **Breast feeding jaundice**
   - It may be due to inadequate intake of breast milk.→ increase enterohepatic circulation
   - It requires increasing the frequency of nursing.

Diagnostic approach: assessment of case neonatal hyperbilirubinemia

1 Diffrentiate between physiological and pathological jaundice

2 Clinical evaluation: History and examination

3 Investigation for unconugated and conjugated jaundice

History

1. Present history

- Time of appearance of jaundice

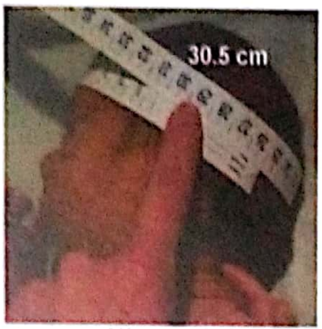
Jaundice staring < 24 hours	Hemolytic disorders especially Rh incompatibility Congenital infection Extra vascular hematoma
2nd and 3rd day	Physiological jaundice - Polycythemia
3rd day to 7th day	Sepsis
Prolonged more than 2-3 week	Unconjugated . Breast milk jaundice . Congenital hypothyroidism . Crigler Najjar syndrome . Infections especially Urinary tract infection . Pyloric stenosis Conjugated: all causes of cholestasis

- The order of baby in the family and previous siblings (Rh incompatibility).
- Color of urine and stool: clay colored stool in cholestasis.
- Lethargy and poor feeding in sepsis

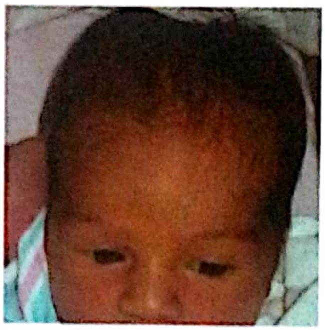
2. **Antenatal history**
   - History of previous abortion or blood transfusion.
   - Maternal illness during pregnancy :(TORCH infection or diabetes).
   - Drug intake e.g. sulphonamide or antimalarial drugs (G6PD deficiency).
3. **Natal**
   - Premature rupture of membranes (septicemia).
   - Mode of termination e.g. traumatic (cephalhematoma).
4. **Nutritional history**: breast feeding (breast milk jaundice).
5. **Family history of similar conditions** : Rh incompatibility or familial hemolytic anemia

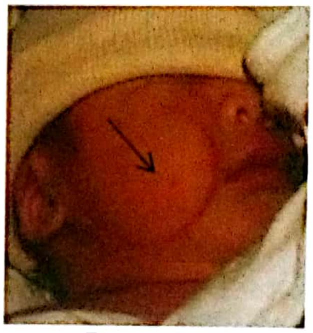
Examination

1. **Measurement:** Head circumference: microcephaly in TORCH infection.
2. **Head**
   - Cephalhematoma, forceps marks.
   - Jaundice.
   - Pallor (suggest hemolytic cause or hematoma).
   - Polycythemia (in infant of diabetic or small for gestational age).

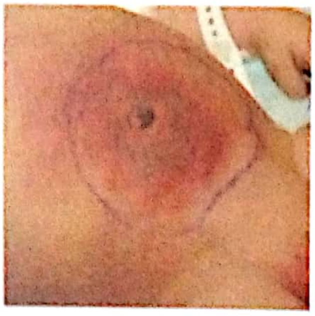


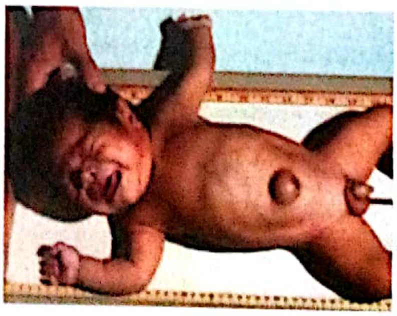
Microcephaly

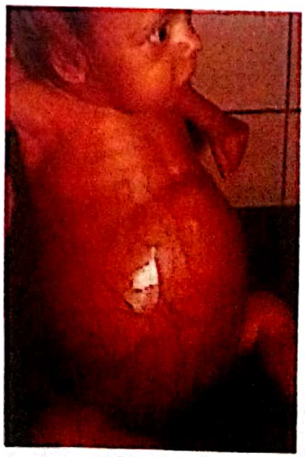

Cephalhematoma


Forceps mark

3. **Trunk**
   - Umbilicus: omphalitis (umbilical sepsis).
   - Skin color: lemon yellow (unconjugated) - greenish (conjugated).
4. **Signs of**
   - **Hypothyroidism** e.g. umbilical hernia or opened posterior fontanel.
   - **Kernicterus** e.g. convulsions, deep jaundice
   - **Cholestasis**: hepatosplenomegaly in cholestatic causes.


Omphalitis


Hypothyroidism


Cholestasis

Investigations

Serum bilirubin (total and direct) to determine type of hyperbilirubinemia
In cholestasis conjugated bilirubin is more than 20% of the total

↓ ↓

Unconjugated hyperbilirubinemia

1. **Blood picture**
   - HB % and reticulocytosis→hemolysis.
   - WBC count and band cell ratio→ septicemia.
2. **To exclude hemolytic disease**
   - Blood grouping (ABO and Rh) for baby and mother.
   - Coombs test (to detect maternal antibodies that coat the baby's RBCs).
3. **To exclude hemolytic anemia**
   - Enzyme assay: G6PD deficiency.
   - RBCs morphology and osmotic fragility test: spherocytosis.
4. **If septicemia is suspected:** C reactive protein- Erythrocyte sedimentation rate-cultures.
5. **Thyroid profile** if not done in neonatal screening program.

Conjugated hyperbilirubinemia

Cholestasis: hepatology : discuss

Treatment of unconjugated hyperbilirubinemia

Principle

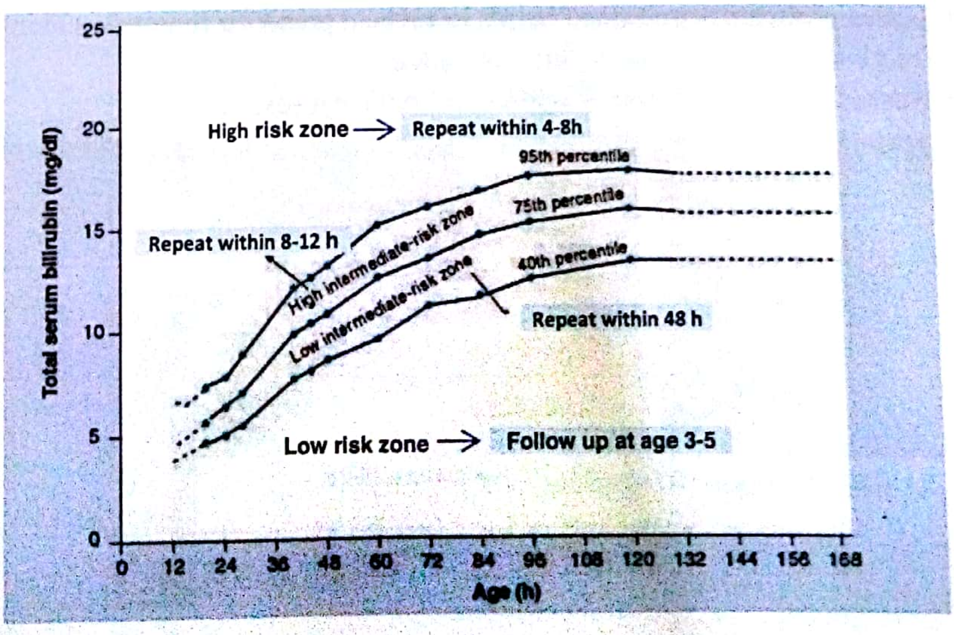
Keep bilirubin level below the neurotoxic level to prevent kernicterus, below 20 mg/dl in the full term newborn and lower levels in preterm

Items

1. Monitoring
2. Phototherapy
3. Exchange transfusion
4. Others : Pharmacological therapy and treatment of the cause

Monitoring

- Screen bilirubin level of any neonates before discharge
- Plot it on an hour-specific nomogram that identifies risk zones



Phototherapy

Principle

Exposure of newborn to light (blue, white or green) of specific wave length (450-460 nm) converts unconjugated bilirubin to non-toxic compounds that are easily excreted through urine and bile.

Indications

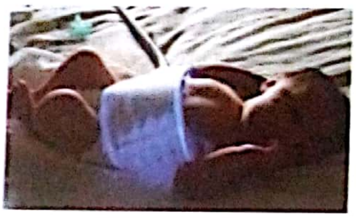
1. Bilirubin level higher than 15 mg% in full term newborn.
2. Before, after or in between exchange transfusions (complementary treatment)
3. Prophylactic in very low birth weight infants, hemolytic disease of the newborn

Effectiveness depends on:

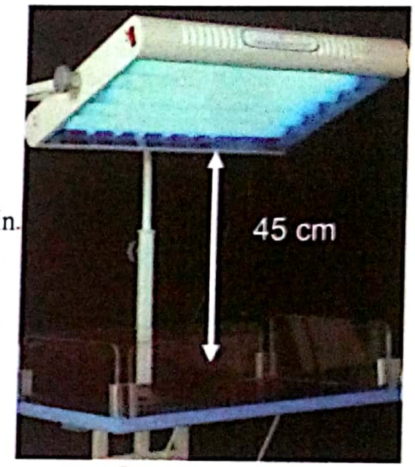
1. Effective range of wave lengths.
2. Distance between the light source and baby: 45 cm
3. Amount of skin exposed (cover only eye and genital)
4. Rate of hemolysis.

Side effects: generally safe

1. Skin: rash, erythema,
2. Stools: loose
3. Dehydration and Hyperthermia,
4. Defective maternal- infant interaction
5. Damage of the retina
6. Bronze baby syndrome: dark grey-brown pigmentation of skin.



Fiber optic blanket



Phototherapy unit

Exchange transfusion

Principle

1. Mechanical removal of bilirubin and antibody coated RBCs.
2. Correction of anemia

Indications

1. **Hemolytic disease of the newborn →early exchange transfusion**
   - Cord bilirubin 5 mg % or more, and or
   - Cord Hb 10 gram %or less.
   - Bilirubin level is rising over 0.5 to 1 mg % /hour in spite of phototherapy.
   - History of kernicterus or severe erythroblastosis in a previous sibling
2. **Healthy full term baby if bilirubin level more than 25 mg/dl in in spite of phototherapy**

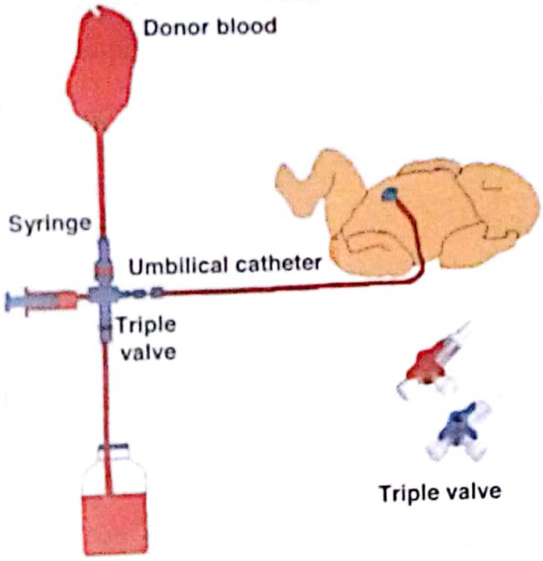
Technique

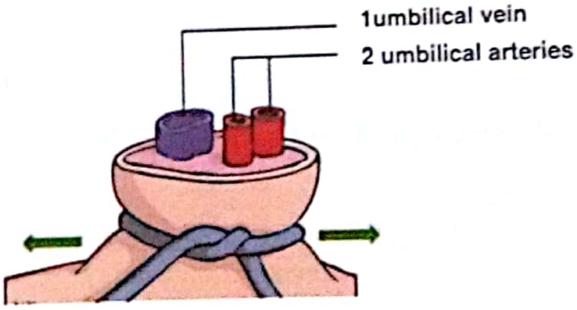
1. Umbilical venous catheter
2. Alternative withdrawing of 5-10 ml of the baby's blood and replacing them with donor blood

3. Type of blood used
   - Rh incompatibility: Rh negative blood cross matched with the mother's blood
   - ABO incompatibility: O (positive or negative) blood cross matched with mother's blood
   - In other cases; the infant's blood group after cross matching

Complications

1. **Complications related to umbilical catheterization:**
   - Vasospasm, thrombosis and embolism
   - Necrotizing enterocolitis
2. **Complications related to used blood**
   - Blood borne diseases.
   - Blood disorders: thrombocytopenia and deficient clotting factors
   - Metabolic: Hyperkalemia, Hypernatremia, Hypoglycemia, Hypocalcemia, hypothermia and acidosis.
3. **Complications related to the technique**
   - Heart failure-volume overload- cardiac arrest or arrhythmia (death in less than 1%)





Pharmacological therapy

1. Intravenous immunoglobulin (500-1000 mg/kg over 2-4 hours) reduces the need for exchange transfusion in isoimmune hemolytic disease.
2. Phenobarbitone: induce glucuronyl transferase enzyme used in only in Crigler Najjar type 2 only (not in other cases as it cause lethargy, poor feeding and need 3-4 days to show effect).
3. Correction of any factors that may increase the risk of kernicterus e.g. hypothermia.

Treatment of the cause

1. Hormone replacement for hypothyroidism
2. Discontinuation of any drug that may interfere with bilirubin metabolism
3. Correction of any factor that may increase the risk of kernicterus e.g. hypoxia, infection and acidosis

Bilirubin Induced Neurological Dysfunction (BIND) and kernicterus

Definitions

BIND: the neurological complications of severe neonatal hyperbilirubinemia in the form of acute encephalopathy only or progression to chronic encephalopathy

Kernicterus is yellow staining of the brain especially basal ganglia due to deposition of free unconjugated bilirubin→ neuronal damage.

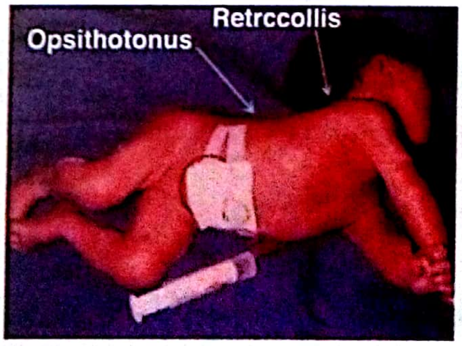
Risk factors

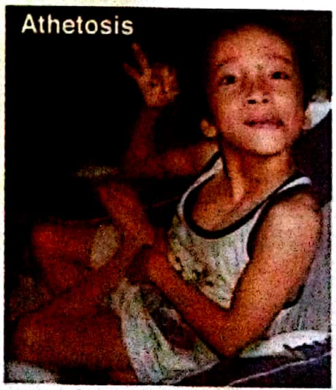
No specific bilirubin level is definitely safe or non-toxic

1. **Bilirubin**
   - Higher levels of FREE unconjugated bilirubin e.g. Rh incompatibility
   - Higher duration of exposure to this high level
   - Higher production e.g. hemolytic causes
2. **Albumin**
   - Reduce albumin levels
   - Reduce albumin binding capacity e.g. prematurity, asphyxia, acidosis , infections
3. **Displacement of bilirubin from its albumin binding sites by**
   - Medications: synthetic vitamin. K, sulphonamide and salicylates
   - Metabolites Fatty acids formed secondary to hypoglycemia, starvation or hypothermia
4. **Infants :** sick infants e.g. asphyxia, hypoglycemia

Clinical picture

1. **Acute bilirubin encephalopathy**
   - Early phase : hypotonia, high pitched cry lethargy and poor suckling
   - Intermediate phase
     - Hypertonia of extensors (opisthotonus and retrocollis), seizures irritability and fever
     - Higher neonatal mortality in this phase.
     - Surviving infants develop chronic bilirubin encephalopathy
   - Advanced phase: marked opisthotonus, sharp cry, apnea, seizures, coma and death
2. **Chronic bilirubin encephalopathy(Kernicterus : post kern icteric cerebral palsy)**
   Mental retardation, athetosis, deafness, limitation of upward gaze and dental dysplasia





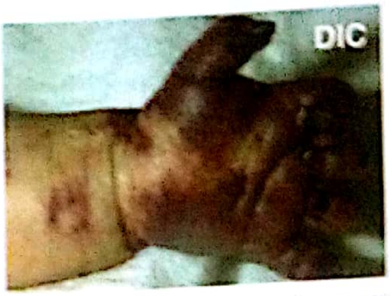
Post kern icteric cerebral palsy

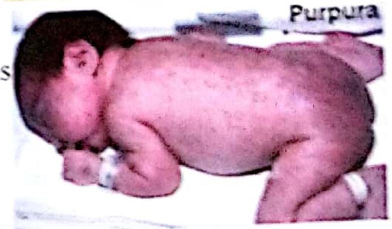
Management

1. Suspected BIND : immediate exchange transfusion , preceded by phototherapy till blood
2. Established cases: Immediate exchange transfusion to minimize further brain damage
3. Prior to discharge : auditory evoked potential for every infant to screen for hearing deficits

Neonatal Bleeding

Etiology





1. **Deficient clotting factors**
    - Transient
      Hemorrhagic disease of the newborn,
      Transient deficiency of vitamin K dependent factors
    - Acquired abnormalities e.g. DIC and liver disease
    - Inherited abnormalities e.g., hemophilia A and B
2. **Thrombocytopenia**
    - Increased destruction
      Immune: neonatal isoimmune or maternal ITP or lupus
      Non immune: infections, DIC
    - Decreased production: e.g. Sepsis
3. **Other causes of bleeding**
    - Birth trauma: cephalhematoma, rupture liver or spleen
    - Prematurity and hypoxia may lead to intracranial or pulmonary hemorrhage

Etiology in relation to the condition of the newborn

Bleeding in healthy newborn	Bleeding in sick newborn
Hemorrhagic disease of newborn	DIC
Neonatal thrombocytopenia	Neonatal septicemia
	Neonatal liver disease

Investigations of neonatal bleeding in general

1. Complete blood picture.
2. Bleeding profile: prothrombin time, prothrombin concentration and partial thromboplastin time.
3. Liver function tests.
4. Fibrinogen and fibrinogens degradation products in suspected DIC

Hemorrhagic disease of the newborn

Incidence

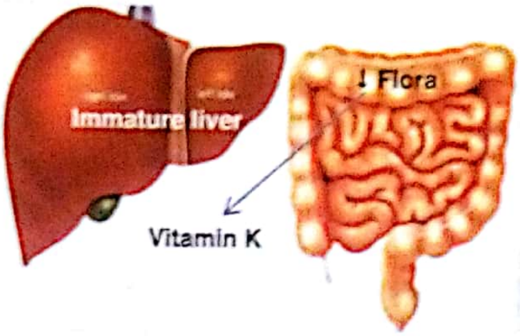
The most common cause of neonatal bleeding- : 2% of newborn if not given vitamin K

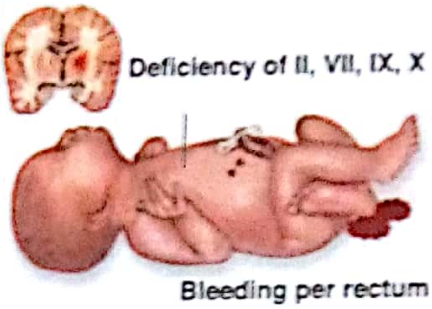
Etiology

1. Transient deficiency of vitamin K dependent factors II, VII, IX, X due to deficiency of vitamin K (absence of bacterial flora).
2. Reduced body stores of vitamin K in the newborn due to lack of vitamin K in the mother
3. Liver immaturity
4. If vitamin K is not given after birth (breast milk is poor source of vitamin K)
5. Disturbance of bacterial flora in the intestine due to use of broad spectrum antibiotics

Clinical picture

1. Commonly present with bleeding between 2nd and 7th day of life.
2. Bleeding per rectum is the commonest site.
3. Other sites: intracranial hemorrhage, injection sites and after circumcision




Deficiency of II, VII, IX, X
Bleeding per rectum

Investigations

1. PT, PTT, and clotting time are prolonged.
2. Decreased levels of factor 2,7,9,10
3. Anemia if there is excessive bleeding

Treatment

1. Preventive: 20 mg Vitamin K to the mother before birth and 1 mg Vitamin K to all newborns shortly after birth.
2. Curative: Vitamin K 1-5 mg IM -fresh frozen plasma or blood transfusion if needed

Neonatal Anemia (physiological- pathological)

Physiological anemia of newborn

Etiology

1. Hemoglobin concentration at birth in full term baby is 15-18 gm% due to relative intrauterine hypoxia stimulating erythropoiesis, at birth this hypoxia is eliminated and erythropoiesis is suppressed.
2. Other factors include
   - Short fetal RBCs life span.
   - Expansion of blood volume during the first 3 months of life.
   - Dietary deficiency of folic acid or vitamin E may aggravate the condition

Onset: It is usually noticed at 8-12 weeks of age

Treatment

1. Asymptomatic: no therapy is required when Hb level is 9 gm/dl or more
2. Symptomatic: packed RBCs transfusions if hematocrit is less than 30% in distressed or oxygen dependent newborn

Intrauterine hypoxia

After birth: hypoxia is eliminated

Pathological anemia

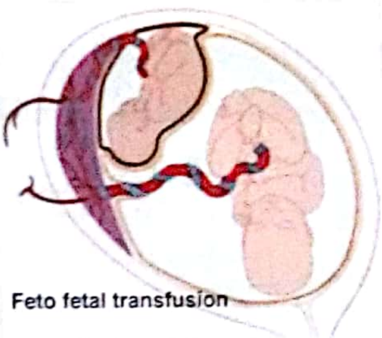
Etiology

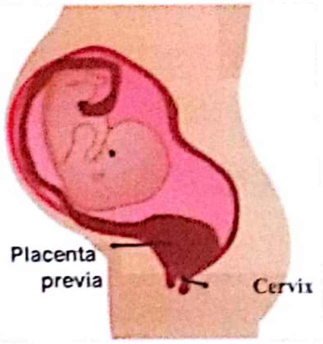
- **Decreased production**
  1. Congenital infections (Rubella or parvovirus) or sepsis
  2. Congenital hypoplastic anemia
  3. Congenital leukemia
  4. Osteopetrosis

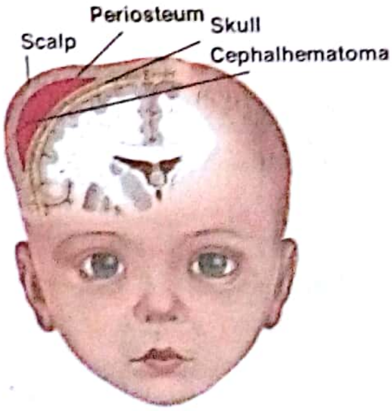
- **Increased loss**

  Hemolysis
  1. Hemolysis: hemolytic anemia (spherocytosis, G6PD and pyruvate kinase deficiency).
  2. Hemolytic disease of the newborn **(RH- ABO incompatibility)**

  Hemorrhage
  1. Occult loss: fetomaternal or feto- fetal transfusion or placental malformation.
  2. Obstetric loss: e.g. placenta previa, placental incision at CS, ruptured cord
  3. Neonatal loss
     - Birth trauma: massive cephalHematoma, Intracranial Hemorrhage, Hepatic or splenic rupture.
     - Hemorrhagic disease of the newborn, bleeding from umbilicus
  4. Iatrogenic loss: frequent blood sampling for investigations.







Clinical picture

1. Acute anemia: pallor, anemic heart failure (tachypnea, tachycardia, enlarged liver) and shock
2. Chronic anemia: pallor, poor weight gain, poor feeding, decreased activity and heart failure in severe cases.

× **Discuss in details hemolytic disease of the newborn (RH- ABO incompatibility): Page 313**

Investigations: discuss from investigations of neonatal Hyperbilirubinemia Page 316

Treatment

1. Whole blood transfusion (15-20ml/kg)
2. Packed RBC transfusion (more commonly used) 10-15 ml/kg
   Blood should be fresh (less than 3 days) and tested for CMV, HIV, hepatitis B and C
3. Recombinant human erythropoietin to prevent or treat chronic anemia

Neonatal Polycythemia

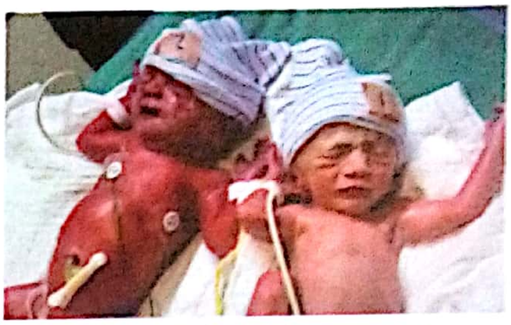
Definition

A hematocrit value of more than 65% and Hb% more than 21 gm/dl

Etiology

1. Placental red cell transfusion
    - Delayed cord clamping or cord stripping
    - Holding the baby below the mother at delivery.
    - Feto fetal transfusion (recipient)
    - Maternal fetal transfusion
2. Placental insufficiency: small for gestational age newborn, preeclampsia, post term
3. Other causes: infant of diabetic mother (hyperinsulinism stimulates the bone marrow)

Delayed cord clamping

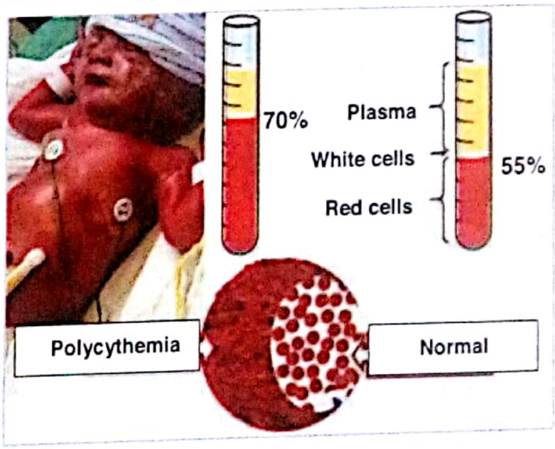

Feto fetal transfusion

Clinical picture

- Asymptomatic: 15-20% of affected newborn.
- Symptomatic
    1. **General**: Plethoric and cyanotic
    2. **CNS**: lethargy, jitteriness, convulsions, hypotonia.
    3. **CVS**: heart failure , renal vein thrombosis
    4. **Respiratory**: distress or apnea.
    5. **GIT**: poor suckling , poor feeding, vomiting , bloody stool or diarrhea
    6. **Metabolic:** Hyperbilirubinemia, hypoglycemia, hypocalcemia, hypomagnesemia

Treatment

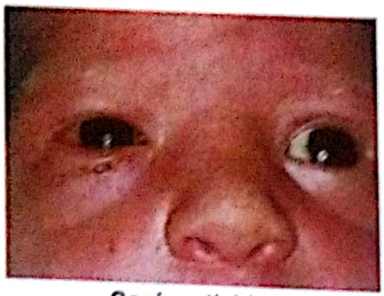
- **Symptomatic**: partial exchange transfusion by fresh plasma or normal saline.
- **Asymptomatic**
    - With hematocrit between 65-70% → IV fluids
    - With hematocrit more than 70% → partial exchange transfusion

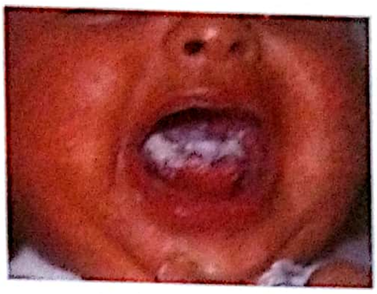


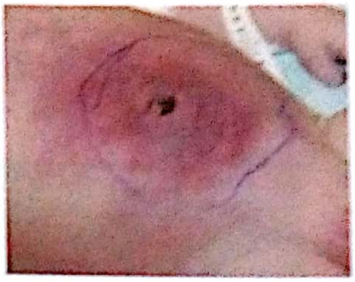
Neonatal Infections

Classification

1. **Congenital infections: TORCH infections : trans placental**
2. **Acquired infections**
   - **Serious infections e.g.** Septicemia, meningitis and pneumonia.
   - **Superficial infections e.g.** conjunctivitis, oral moniliasis and umbilical infections


Conjunctivitis

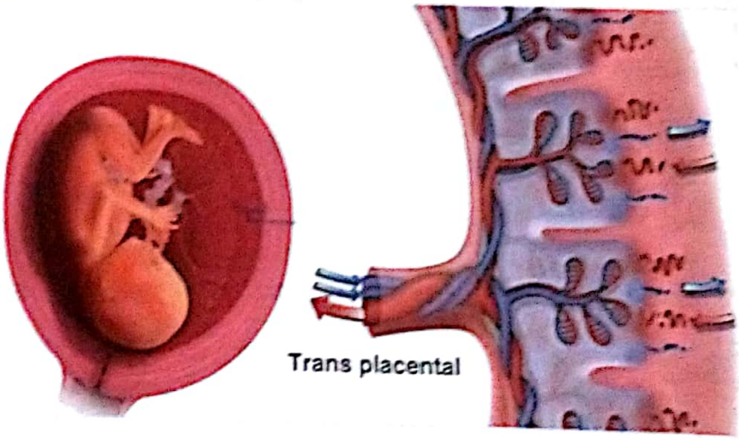

Oral moniliasis


Omphalitis: umbilical infection

Congenital infections: TORCH infections

Etiology

1. Toxoplasmosis.
2. Others
   - Syphilis, AIDS.
   - Parvovirus B19, Hepatitis B
   - Varicella Zoster
   - Chlamydia
3. Congenital Rubella.
4. Cytomegalovirus.
5. Herpes simplex virus type 2


Trans placental

Common clinical presentations (when to suspect congenital infection)

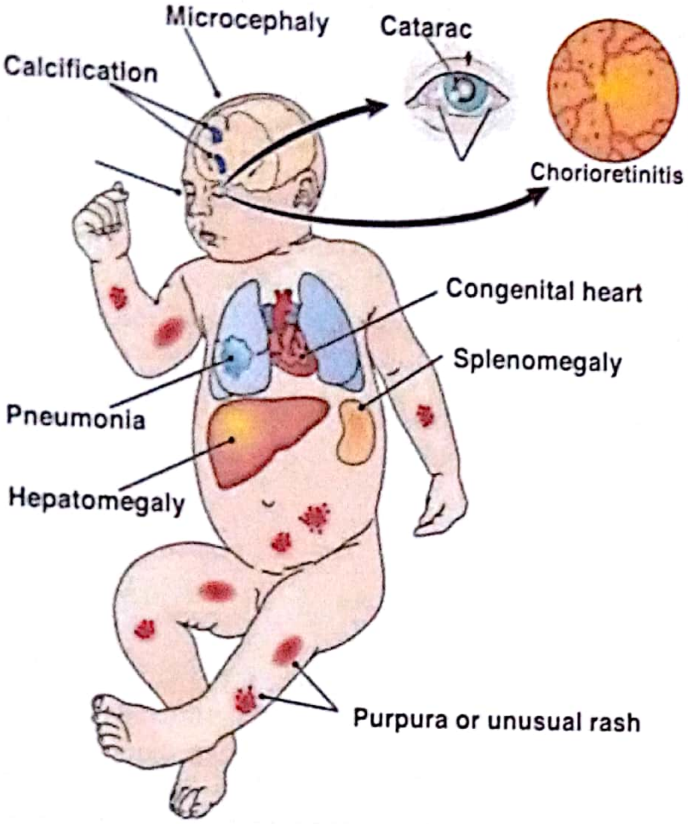
General features

1. Suggestive maternal history: fever during pregnancy.
2. Small for gestational age (intrauterine growth retardation).
3. Skin: thrombocytopenia or unusual rash.
4. HepatoSplenomegaly.

Specific features that may suggest the cause

1. Seizures: Toxoplasmosis, CMV, Herpes simplex.
2. Chorioretinitis: Toxoplasmosis and CMV.
3. Calcification intracranial: Toxoplasmosis and CMV (periventricular calcification).
4. Congenital cataract: congenital rubella and herpes simplex.
5. Congenital heart disease: rubella.

6. **M**icrocephaly (Rubella and CMV) or Macrocephaly and hydrocephalus (Toxoplasmosis).
7. **M**ucous membrane, eye and skin lesions: herpes simplex.



Purpura

Investigations

1. **Toxoplasmosis**: high serum IgM antibody
2. **Rubella**
   - Virus detection (from urine, blood, throat or nasal samples: early as possible): PCR
   - Serological tests: high IgM antibody: may persist for 6-12 months
3. **CMV**
   - Virus detection (from urine, saliva, blood or other tissues within 2-3 weeks after birth by viral cultures or PCR.

     Congenital CMV cannot be diagnosed if the infant is tested more than 2-3 weeks after birth (because the baby could have contracted the infection through nursing or by exposure to siblings or others who may be shedding the virus)
   - Serological tests cannot be used to diagnose congenital CMV
4. **Herpes simplex**
   - Virus detection by virus DNA PCR or viral cultures.

Treatment

Specific antiviral antimicrobial drugs and intensive supportive care

Neonatal Septicemia

Incidence

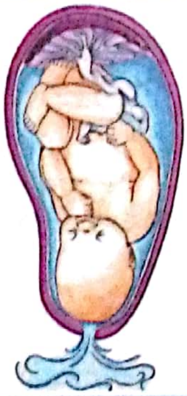
The commonest cause of death in neonates.

Etiology

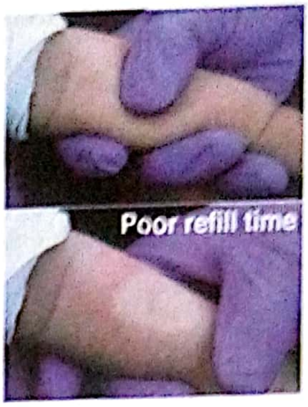
1. The commonest organisms in Egypt are gram - Ve organisms: Klebsiella, E-coli, Proteus and Pseudomonas.
2. Other organisms are: gram +Ve: staphylococcus aureus and B streptococci

Clinical picture

According to the onset of manifestations neonatal septicemia is classified into:

	Early onset infection	Late onset infection
Onset	Less than 72 hours of life	After 72 hours of life
Source	Birth canal: **ascending**	Infant's environment: **nosocomial**
Bacteria	is acquired before or during delivery	is acquired after delivery
Risk factors	. Prematurity . Prolonged rupture of membranes>18 h . Purulent or foul smelling liquor . Maternal infection during pregnancy . Intrapartum infection Maternal fever more than 38 C Maternal UTI Leukocytosis more than 18000/mm^3 	. Prematurity the main factor . Procedures: catheters, intubation . Perinatal asphyxia . Parenteral nutrition and delay enteral feeding . NICU admission - Inadequate infection control - Inadequate nursing staff - Two crowded units . Male gender??? . Low birth weigh
Organism	.Gram -Ve enteric bacilli e.g. Klebsiella . Enterococci . Coagulase - Ve staphylococci and listeria monocytogenes . B streptococci	. Coagulase $^{-}$ Ve staphylococci . Staphylococcus aureus (methicillin resistant staph) MRSA . Gram -Ve enteric bacilli . B streptococci
Clinical presentations	. Fulminant course . Multisystem . Pneumonia is frequent . 80-90% are symptomatic at birth with respiratory distress . 10% have meningitis	. Slowly progressive course . Focal . Meningitis is frequent

Clinical manifestations are usually vague and nonspecific.



High index of clinical suspicion is needed for early diagnosis

Early signs

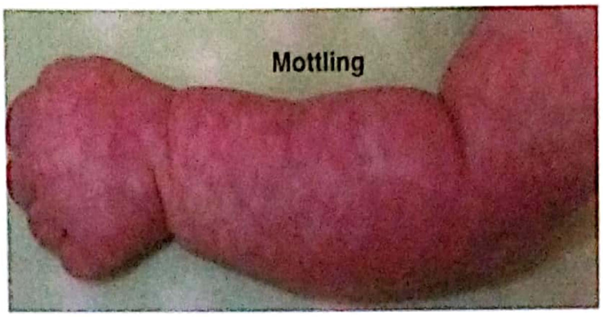
1. Lethargy, drowsiness and not doing well baby.
2. Poor feeding, vomiting, and abdominal distention.

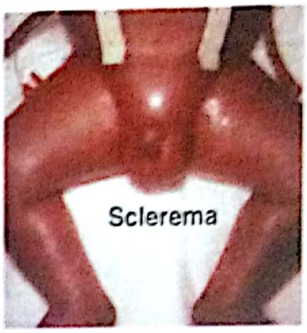
Vital signs

1. Temperature: fever or hypothermia (or temperature instability).
2. Respiratory rate: tachypnea, apnea or irregular breathing.
3. Bradycardia

Other signs: complications

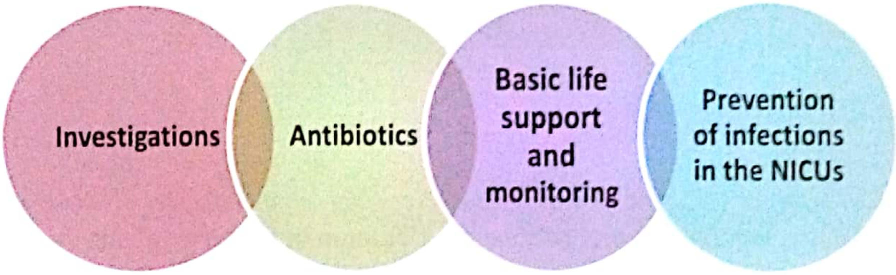
1. DIC→ purpura and bleeding. Acute hemolysis →Jaundice
2. Septic shock (mottling, poor refill time) and Septic renal failure.
3. Sclerema.
4. Septic localization e.g. meningitis (bulging anterior fontanel, seizures).





Management of neonatal sepsis

1. **Full term + risk factors + asymptomatic ▶ do sepsis screen+ observation**
2. **Full term +risk factors+ symptomatic ▶do sepsis screen** (including blood culture) **+ start antibiotics**
3. **Preterm ± risk factors ▶ do sepsis screen** (including blood culture) **+ start antibiotics**


Investigations
Antibiotics
Basic life support and monitoring
Prevention of infections in the NICUs

Investigations: septic screen

1. **Complete blood picture**: leukocytosis above 15000 cells/mm^3 or less than 5000 cell/mm^3 Neutropenia < less 1800. I/T ratio: immature neutrophil to total neutrophil is > 20%
2. **Acute phase Reactants**
   CRP (a negative CRP is < 6mg/dl)
   Micro ESR (above 15mm in the first hour).
3. **Blood cultures:** (positive in 50% of cases)
4. **Swabs** from eyes, ear, umbilicus
5. **CSF examination**.
6. Hypoglycemia or hyperglycemia

Antibiotic

1. **Route** : IV (avoid oral and IM route due to poor absorption)
2. **Duration**
   - Probable sepsis : 5-7 days
   - Clinically definite sepsis but culture -Ve : 10-14 days
   - Proven culture +Ve sepsis: 14 days.
   - Meningitis: 3 weeks.
   - Septic arthritis 4-6 weeks.
3. **Protocol**
   - **First line :** Penicillin e.g. ampicillin + Aminoglycoside e.g. Gentamycin or Amikacin
   - **Second line:** 3rd generation cephalosporins + Aminoglycosides
   - × Antibiotics are modified according to the results of cultures and antibiotic sensitivity
   - × Some antibiotics are not to be used unless recommended by culture results to avoid emergence of resistant strains e.g. vancomycin and Tinam.

Basic life support and monitoring: Page 296

Measures to prevent /minimize infections in the community, nurseries and NICUs

Caregiver

1. Hand washing by care givers : the most important
2. Proper hygiene of the caregiver

Baby

1. Exclusive breast feeding (especially colostrum)
2. Keep cord dry and uncovered(no powder or antibiotic ointment application)
3. No necessary intervention- strict aseptic technique during procedures e.g. ET intubation
4. Proper management of IV lines

Unite

1. Cots and incubators should be well spaced
2. Disinfection of equipment in general and humidifier in particular

Necrotizing enterocolitis

Etiology

Bacterial invasion of ischemic bowel wall that may be accelerated by feeding with milk. The disease may progress to bowel perforation. **Common in Preterm** infants fed cow's milk formula.

Diagnosis

1. Vomiting (may be bile stained)
2. Stool may contain fresh blood.
3. Distended abdomen.
4. Shock (septic).

Investigations

5. X ray: air in the bowel wall and in the peritoneum.
6. Blood picture: thrombocytopenia

Treatment : significant morbidity and mortality

1. Stop oral feeding and instead, give parenteral nutrition
2. Broad spectrum antibiotics (cover aerobic and anaerobic organism
3. Mechanical ventilation

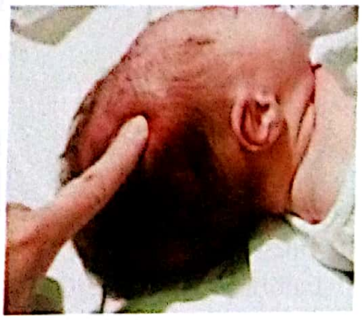
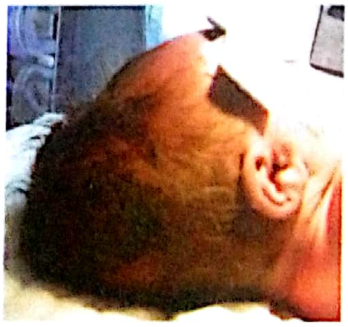
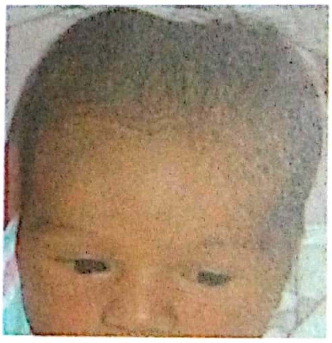
Birth Injuries

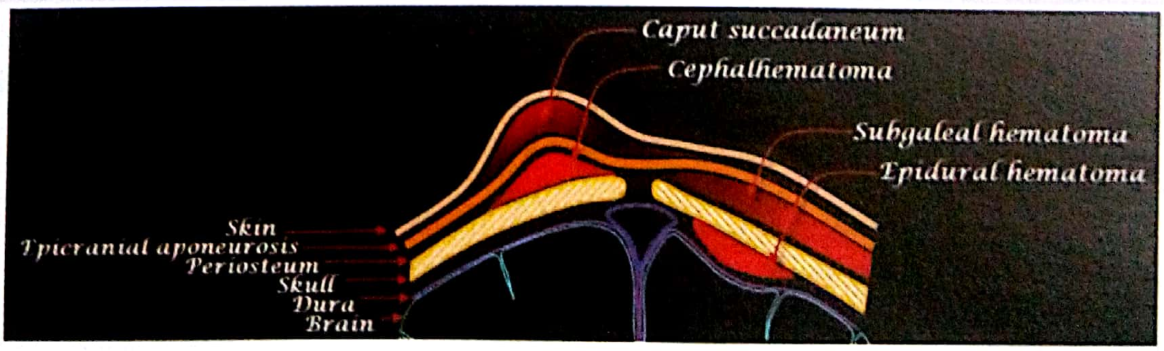
Risk factors

1. **Maternal** : Primigravida, short stature
2. **Fetal**: abnormal presentation e.g. breech, very low birth weight or macrosomia or oligohydramnios
3. **Labor**: prolonged or short labor, obstructed , use of forceps or vacuum

Types

3. Cranial injuries: subgaleal hemorrhage, cephalhematoma, intracranial hemorrhage.
4. Nerve injuries: cranial or peripheral
5. Muscles and skeletal injuries
6. Intrabdominal and visceral injuries

Caput succedaneum	Subgaleal hemorrhage (Subaponeurotic)	Cephalhematoma (Subperiosteal)
Pathology Edema of the subcutaneous tissues	Blood under Galeal aponeurosis	Blood between Periosteum and skull bones
Picture **Swelling** . Presents at birth over the presenting part (moulding is usually present) . Crosses suture lines . Disappears after 1-2 days	. Presents at birth and may increase in size rapidly . Crosses suture lines . Disappears in weeks	. Presents hours after birth: 2nd or 3 rd day . Limited by suture lines . Disappears in weeks
Complications: No	. Anemia, Jaundice and hypovolemia (blood loss)	2-May be anemia and Jaundice, skull fracture
		
Treatment : Nothing	. Antibiotics . Blood transfusion if there is significant anemia	. Antibiotics . Blood transfusion if there is significant anemia . Aspiration is contraindicated



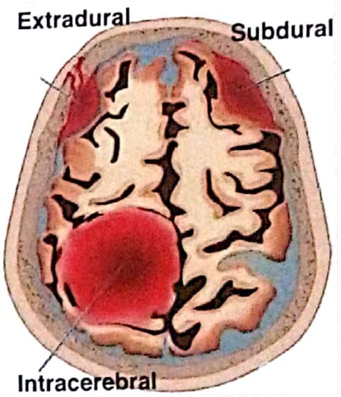
Intracranial hemorrhage

Incidence: mainly in preterm, it occurs in 40% of preterm babies below 34 weeks:

Etiology: Predisposing factors
- Coagulation defects . Congenital vascular anomalies. . Convulsions
- Birth anoxia. Birth trauma

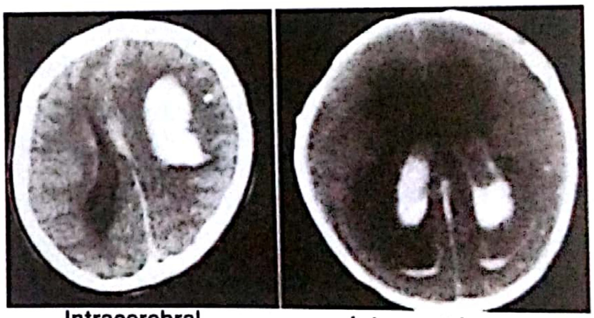
Pathology
- Occur in the germinal matrix which contains fragile blood vessels, it is usually spontaneous.

Clinical picture and complications
1. The majority of intracranial hemorrhage occur within first 72 hours
2. The severity of symptoms depends on size, site (subdural, extradural, Intracerebral, intraventricular and subarachnoid) and rapidity of hemorrhage, it may be silent in 50% of cases.
3. C F A H
   - **C**onvulsions and disturbed **C**onscious level
   - **F**ontanel is bulging, suture separation
   - **F**eeding is poor(increased intracranial tension)
   - **A**pnea and **A**nemia (in severe cases due to excessive blood loss)
   - **H**yperbilirubinemia(red cell breakdown)
   - **H**ydrocephalus(gliosis and obstruction of CSF flow)



Investigations
1. Ultrasound: the procedure of choice for screening and diagnosis.
2. It should be done for all preterm infant lea than 32 weeks gestation or who presents with abnormal neurological findings.
3. CT or MRI in some cases

Treatment
1. Supportive measures:
   - Blood transfusion if needed
   - Vitamin k to treat coagulopathy
2. Control of convulsions by Phenobarbitone.
3. Neurosurgical consultation


Intracerebral Intraventricular

Erb's palsy

Etiology
- Injury to cervical roots C5, C6 usually due to traction on head or shoulder during delivery of the after coming head of breach.

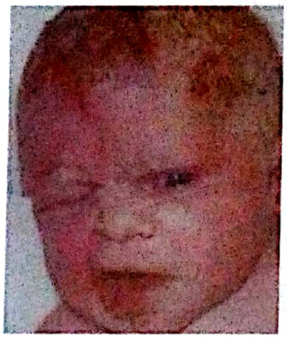
Picture
1. Flaccid paralysis of the upper limb.
   It is held in adduction, internal rotation and pronation (policeman tip).
2. Moro reflex is absent on the affected side but grasp reflex is intact.

Treatment
1. Physiotherapy after 2 weeks (not at birth).
2. Neuroplasty may be needed.

Phrenic nerve paralysis (C3-4-5)

1. It results in paralysis of the diaphragm
2. Most injuries are unilateral and are associated with ipsilateral upper brachial plexus palsy

Facial palsy



Etiology

Compression of the facial during delivery

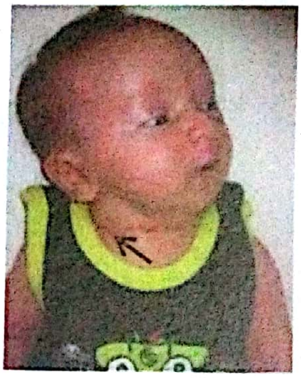
Picture

Unilateral weakness of facial muscles (lower motor neuron).

Treatment

Resolve spontaneously within few weeks after delivery.

Muscle injuries: the commonest is stern mastoid tumor



It is hematoma due to swelling of the lower half of muscle

Etiology

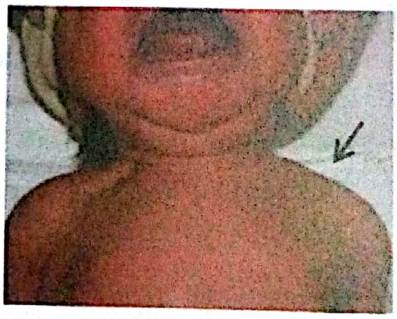
1. Abnormal intrauterine position e.g. lateral extension of the neck
2. During difficult delivery as the muscle is hyperextended →rupture and hematoma develop

Clinical picture

1. Head titling towards the involved side. The chin is elevated and rotated
2. Subsequent fibrosis it may occur → torticollis if neglected

Treatment: physiotherapy

Bone injuries: clavicle (the commonest) and long bone injuries



Etiology: shoulder dystocia or in breech

Clinical picture

1. Reduced arm movement on the affected side (due to pain)
2. Moro reflex is absent on the affected side

Investigations: X ray is diagnostic

Treatment

1. Lifting the child gently to prevent discomfort
2. Arm immobilization under the clothes may be done

Abdominal injuries: (the commonest is splenic and adrenal hemorrhage)

Clinical picture

1. Sudden onset due to extensive injury: shock, abdominal distension
2. Insidious onset: pallor, jaundice, tachycardia and tachypnea.
3. Any shocked newborn with abdominal distension and history of traumatic or prolonged delivery should be suspected of having an internal injury.

Investigations

1. Abdominal ultrasonography
2. Serial hematocrit value

Treatment

1. Supportive and Paracentesis if there is excessive intraperitoneal hemorrhage

Neonatal Surgical Emergencies

Choanal atresia

Pathology

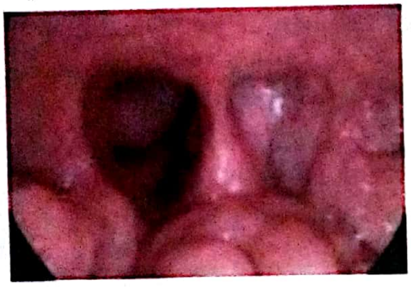
- Obstruction of the posterior nares by bony (more common) or membranous septum.
- It may be bilateral (needs immediate management) or unilateral (discovered accidentally).

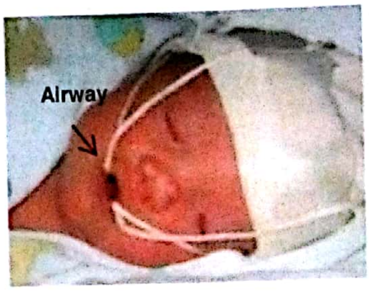
Diagnosis

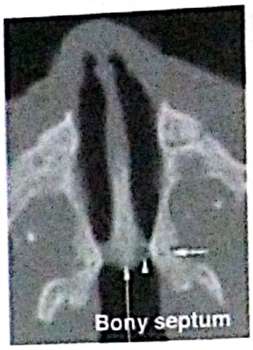
1. Cyanosis on closure of the mouth or feeding (baby are obligate nasal breathers)
2. **Cyanosis improves when the baby cries, as the oral airway passage is used at this time**
3. Inability to pass a suction catheter through the nares (this should be done routinely in neonates at birth)

Treatment

- Keep the mouth opened using airway followed by surgical treatment.







Diaphragmatic hernia

Pathology

- Part of the intestine with or without the liver herniates through an opening in the diaphragm during intrauterine life.
- It is usually associated with hypoplasia of the lungs (no space for development) .

Clinical picture

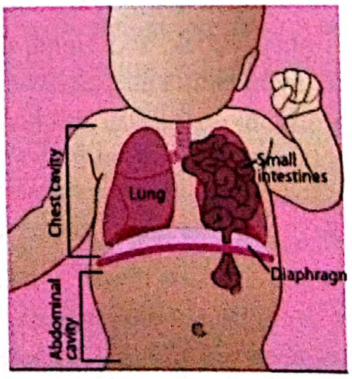
1. Severe respiratory distress at birth. Some cases present with failure to resuscitation.
2. The apex beat is displaced to the right side (herniation is on left side usually).
3. Scaphoid abdomen.

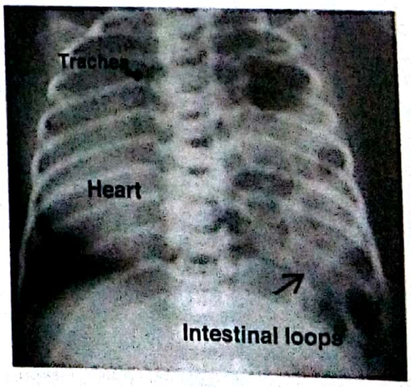
Investigations

- X ray is diagnostic.

Treatment

1. Nasogastric suction to prevent distention of the intra thoracic bowel.
2. Respiratory support and surgical treatment.





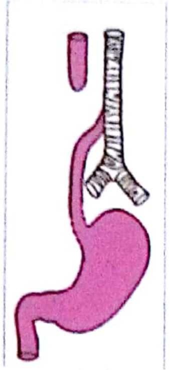
Tracheo-oesophageal fistula

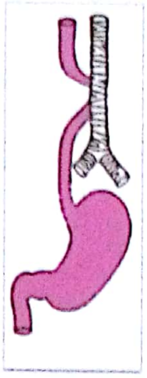
Pathology

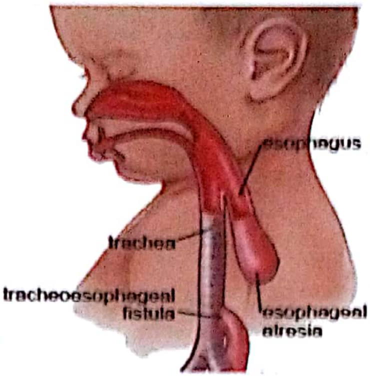
- Fistula between the trachea and the upper or lower part of the esophagus.

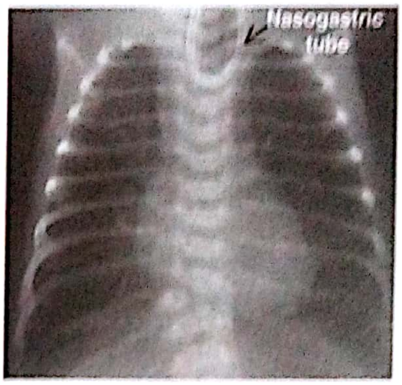
Diagnosis

1. Choking, dribbling of saliva and respiratory distress.
2. X ray with nasogastric tube in the esophagus (seen curved).







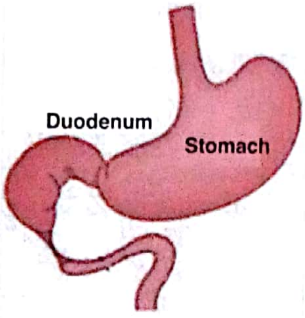


Congenital intestinal obstruction

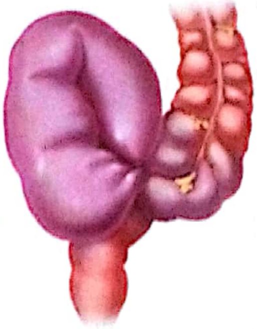
Causes: duodenal atresia, volvulus, Hirschsprung' disease

Diagnosis

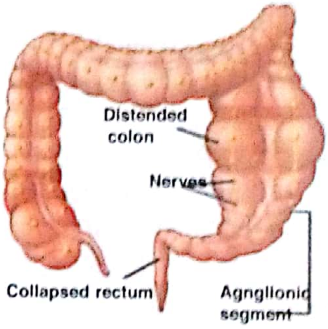
1. Bilious vomiting
2. Abdominal distension.



Duodenal atresia



Volvulus

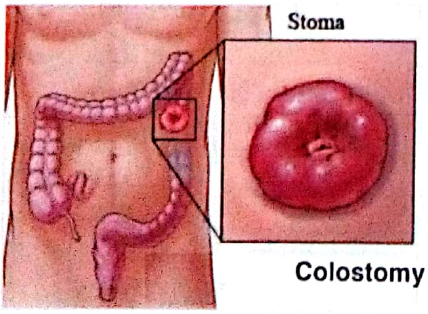


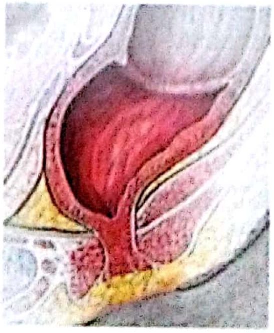
Hirschsprung's disease

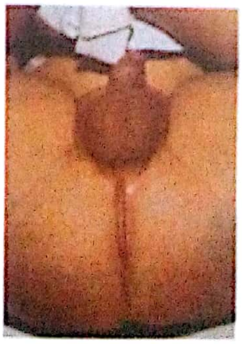
Markedly distended abdomen

Imperforate anus

1. Should be excluded in routine examination of any neonate
2. Detailed examination as anomalies are found in 60% of cases.
3. Most cases need colostomy performed in the neonatal period.
4. Surgical repair is performed later on.







General Principles Of Emergency Medicine

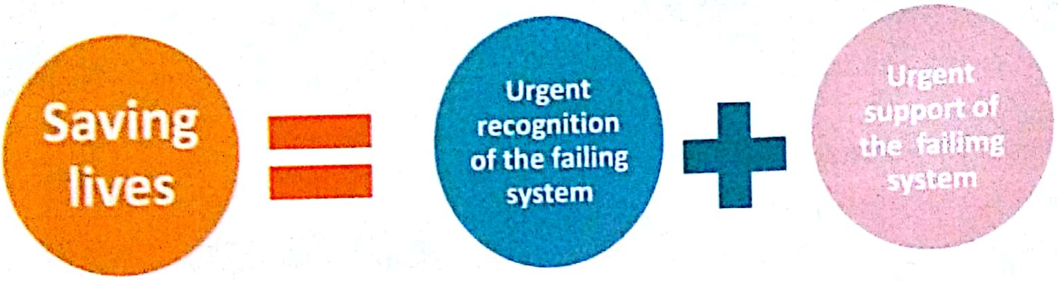
Definition

It is the field of medicine that deals with acute life threatening conditions in which death may occur if urgent measures are not performed to preserve life

Differences from other medical subspecialties

1. Deals with all systems at the same time
2. Special approach : emergency approach
3. Rapid recognition of problems and rapid intervention is needed
4. Need knowledge and skills

Objectives


Saving lives
=
Urgent recognition of the failing system
+
Urgent support of the failimg system

Places and levels of emergency care

1. **Emergency department (ED)**
   It deals with mild to moderate cases in which management requires a period less than 24 hours.
2. **Intermediate care unit**
   It deals with cases need management for more than 24 hours. It receives cases from emergency department (if treatment need more than 24 hours) or intensive care units after improvement.
3. **Intensive care unit (ICU)**
   Deal with severe serious cases in which intensive care and special equipment are needed to reserve life. They receive cases from emergency department or from intermediate care

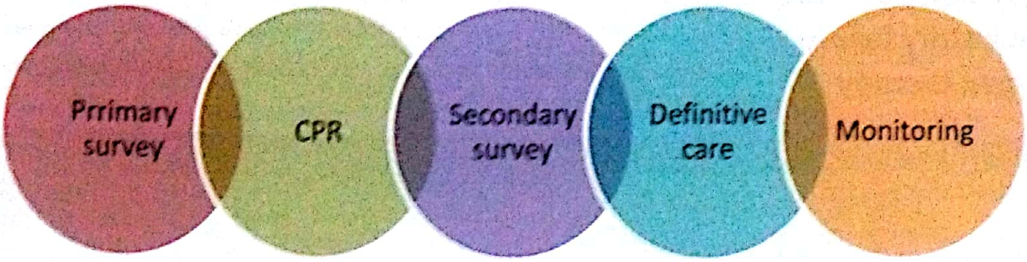
System failure and system support

1. **Single system failure**
   It occurs with any serious illness of one system e.g. respiratory failure complicating severe pneumonia.
2. **Multiple organ system failure**
   - Secondary to advanced single system failure.
   - Following cardiopulmonary resuscitation.
   - With serious injuries e.g. burns or major trauma.

On dealing with patients with system failure, system support is more important than specific treatment directed towards the primary illness, for example a patient with severe bacterial pneumonia and respiratory failure needs immediate oxygen (system support) more than antibiotics (specific treatment).

The emergency approach of critical illness

The classic approach (History, examination, investigations, etiological diagnosis and treatment) cannot be applied in emergency medicine. In emergency medicine, emergency approach is used to deal with critical conditions. It is 5 successive steps



1. **Primary survey**

   It aims to discover those in need of resuscitation

   A: Airway: check if the airway is patent or not.
   B: Breathing: check if the patient is breathing or not.
   C: Circulation: check if the heart is beating or not.
   D: Disability: check if the patient is conscious or not.
   E: Exposure: uncover the patient to look for injuries or bleeding.

2. **Cardiopulmonary resuscitation (CPR) in cases with cardiopulmonary arrest**
3. **Secondary survey**: It aims to discover the failing system or systems.

   Respiratory failure
   - Type 1 failure: respiratory distress due to severe lung or airway pathology.
   - Type 2 failure: respiratory depression due to coma or respiratory muscle paralysis.

   Cardiovascular failure
   - Heat failure: tachycardia, tachypnea and tender liver.
   - Circulatory failure (shock): poor peripheral perfusion, tachycardia and hypotension.

   Neurological failure
   - Convulsions: repetitive involuntary muscle contraction.
   - Coma: unresponsiveness to painful stimuli.

   Metabolic failure
   - Dehydration: sunken eyes, dry tongue and lost skin turgor.
   - Acute renal failure: oliguria or anuria.

   Hematological failure
   - Acute hemolytic anemia: sudden pallor with tachycardia and jaundice.
   - Bleeding.

4. **Definitive care**
   - **Nonspecific support of the failing system**
     - **Respiratory support**: oxygen therapy, suctioning and positive pressure support.
     - **Cardiovascular support**: oxygen, preload and aferload reduction and inotropes.
     - **Neurological support**: convulsions control and reduction of ↑ intracranial tension
     - **Metabolic support**: correction of dehydration.
     - **Hematological support**: transfusion and control of bleeding.
   - **Specific treatment of the causative disease**

5. **Monitoring**
   - **Clinical**: recording clinical change every 1-2 hours.
   - **Laboratory**: recording laboratory changes.
   - **Therapeutic**: recording changes in management.

Respiratory Emergencies

Stridor
Respiratory distress
Respiratory failure
Oxygen therapy

Stridor

Definition

It is a harsh inspiratory sound produced by partial obstruction at the level of the larynx or trachea.

Incidence

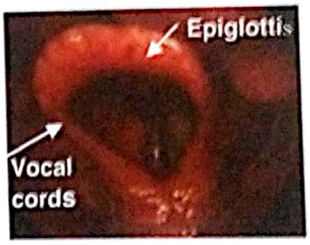
Common in infancy and young children (smaller airway).

Etiology

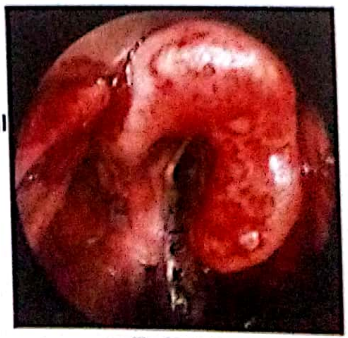
Infections: croup

- **Viral: 90 % of cases**
  Etiology: Parainfluenza virus, influenza virus and adenovirus.
  Clinical picture: barking cough, harsh stridor and hoarseness, with fever and coryza.
  1. Acute laryngitis: most common- mild fever.
  2. Laryngotracheobronchitis: inspiratory and expiratory sounds- moderate fever.
  3. Spasmodic laryngitis (occurs mainly at night-absent fever).

- **Bacterial tracheitis**
  Etiology: Hemophilus influenza type b or staphylococcus
  Clinical picture: high fever, toxic appearance, severe progressive stridor



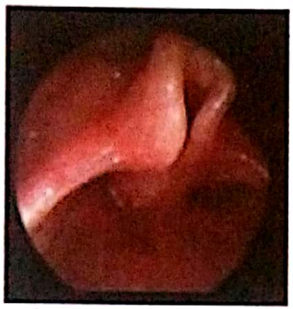
- **Acute epiglottitis: acute life threatening illness**
  Etiology: Hemophilus influenza type b.
  Clinical picture: very acute onset.
  1. High fever and toxic appearance.
  2. Distress: severe progressive stridor
  3. Dysphagia: sever sore throat prevents the child from speaking or swallowing, with Drooling of saliva
  4. Children with epiglottitis sit upright with their neck extended and head forward while drooling and breathing through their mouth.

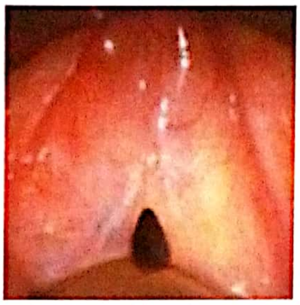


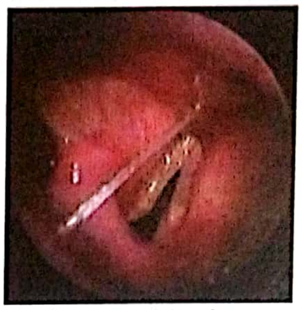
Epiglottitis

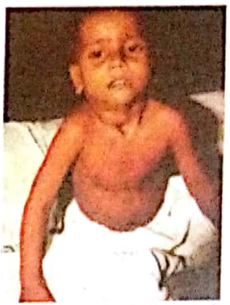
Other causes

1. **Laryngospasm** (may occur with hypocalcemic tetany)
2. **Laryngomalacia**: recurrent or continuous stridor since birth.
3. **Laryngeal edema** with severe allergy or following extubation.
4. **Laryngeal foreign body**: chocking on peanut or toy in mouth.
5. **Laryngeal compression** with retropharyngeal hematoma or abscess
6. **Laryngeal diphtheria** or measles and infectious mononucleosis.


Laryngomalacia


Laryngeal edema


Laryngeal foreign Body: fish bone


Laryngeal diphtheria

Clinical grading of stridor

1. Grade I: exertional stridor: during crying or exercises.
2. Grade II: stridor at rest, become worse with crying.
3. Grade III: stridor with retractions (suprasternal and supraclavicular).
4. Grade IV: stridor with respiratory failure: cyanosis and disturbed consciousness.

Treatment

Home management: stridor grade 1 or grade 2 in children > 1year old

1. Warm steam inhalation relieves minor obstruction.
2. Oral steroids or nebulized steroids reduce the severity and duration of croup.
3. Close observation: worsening → hospital management.

Hospital management

- **Indications**
  1. Grade II in infant < 1 year
  2. Grade III or IV (grade IV stridor need immediate intubation)
  3. High fever and severe obstruction (suspected bacterial disease)
- **Treatment plane**
  1. Oxygen therapy (masks, head box) follow up by pulse oximetry.
  2. Warm steam inhalation: ultrasonic nebulizer.
  3. Parenteral steroids to decrease laryngeal edema.
  4. Antibiotics in suspected bacterial disease.
  5. Close observation: worsening→ endotracheal intubation.
- **Treatment of acute epiglottitis : ICU**
  1. Intubations should be done under controlled conditions.
  2. Parenteral antibiotics: cephalosporin.
  3. With proper treatment most children recover within 2-3 days.

Ultrasonic Nebulizer

× **Don't examine the throat by tongue depressor, total obstruction may occur, resuscitation equipment and personnel must be available before looking at the throat**

Respiratory Distress

Etiology: revise causes of neonatal respiratory distress

1. **Pulmonary**
   - Pneumonia. Acute bronchiolitis . Acute severe asthma.
   - Pneumothorax . Pleural effusion. Pulmonary edema.
   - Massive collapse . Respiratory distress syndrome.
2. **Other causes**
   - Acute congestive heart failure (tachycardia-tachypnea and tender liver).
   - Acute metabolic acidosis: deep rapid respiration.
   - Acute severe anemia.

Clinical grading of respiratory distress

Grade I	Mild distress = increased rate of breathing: Tachypnea and working alae nasi.
Grade II	Moderate distress=increase depth of breathing: Intercostal and subcostal retractions.
Grade III	Severe distress= increase pressure of oxygenation: Expiratory grunting.
Grade V	Advanced distress= failure of compensation Cyanosis or altered consciousness.

Respiratory Failure

Definition

Failure of respiratory system to perform its main functions (which are oxygenation and co2 elimination) with arterial oxygen pressure ≤ 50 mmHg and Co2 pressure above 50 mmHg.

Etiology and clinical types of respiratory failure

Lung failure(type 1 respiratory failure)	Pump failure (type 2 respiratory failure)
Basic defect: arterial hypoxemia (↓ oxygenation)	**Basic defect**: hypoventilation ↓co2 elimination
Etiology(severe lung pathology)= distress causes 1. Severe pneumonia. 2. Severe bronchiolitis. 3. Acute severe asthma. 4. Pneumothorax (tension). 5. Pleural effusion (massive). 6. Pulmonary edema 7. Massive collapse. 8. Respiratory distress syndrome.	**Etiology** 1. Respiratory depression CNS infection. Intracranial hemorrhage. 2. Respiratory muscle paralysis or fatigue Guillain Barre syndrome. Poliomyelitis. 3. Respiratory muscle fatigue: severe type 1 failure.
Clinical picture 1. Respiratory distress 2. Chest signs of the cause.	**Clinical picture** 1. Deep coma (cases with brain pathology). 2. Shallow and or irregular breathing. 3. Severe respiratory distress in cases due to severe type1 failure.
Arterial blood gases Low Pao2: below 50 mmHg ± hypoventilation. Acute metabolic acidosis,	**Arterial blood gases** Hypoventilation: High Paco2± hypoxia. Acute respiratory acidosis.

Management of respiratory failure

Respiratory monitoring

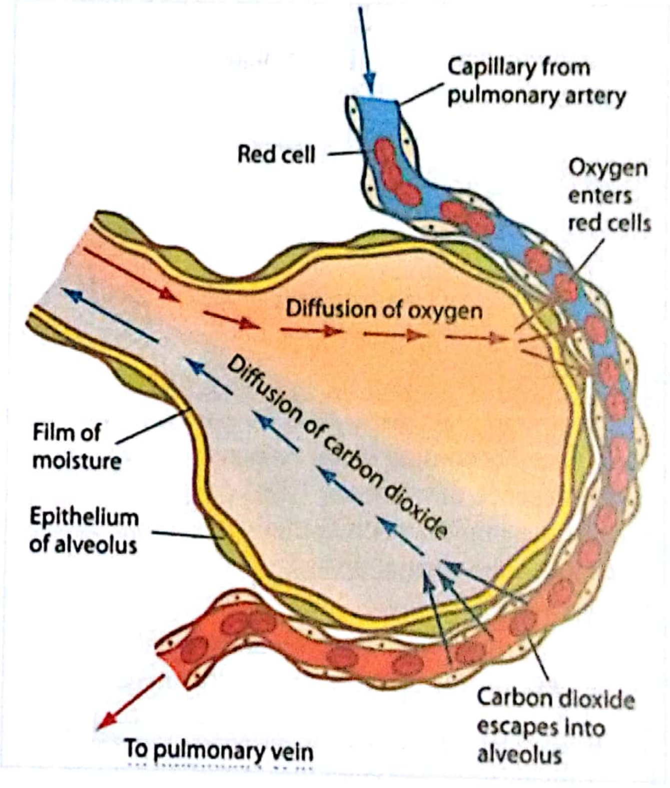
1. Clinical monitoring:
   - Vital signs: heart rate, respiratory rate, blood pressure and temperature.
   - Degree of respiratory distress, color of the patient and peripheral perfusion
2. Arterial oxygen saturation by pulse oximetry: see below
3. Arterial blood gases (clinical book)

Respiratory support

1. Oxygen therapy: to correct hypoxia, it is the most important line of therapy.
2. Aerosol therapy to liquefy airway secretion.
3. Chest physiotherapy and suctioning to improve ventilation.
4. Positive pressure ventilatory support (PPVS)

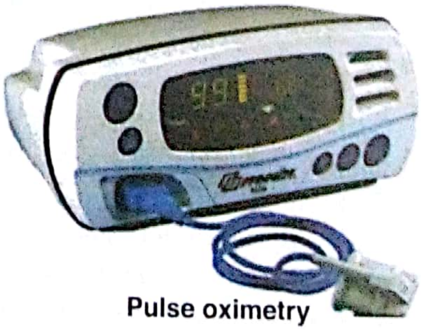
Specific treatment: according to the causative disease

Carbon dioxide diffuses 20 times more rapidly than the Oxygen



Pulse oximetry: measures oxygen saturation

- **Advantages** : simple, reliable and noninvasive
- **Disadvantages**: can't measure hyper oxygenation
- **Limitations**
  - Shock (poor perfusion)
  - Methemoglobinemia
  - Optical interference.
- **Normal values** : see oxygen therapy



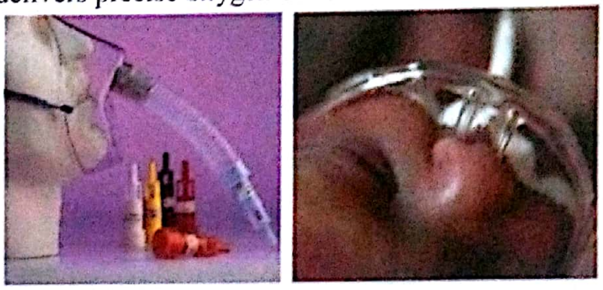
Pulse oximetry

Oxygen Therapy

Indications
1. Respiratory distress
2. Respiratory failure
3. Circulatory failure: shock
4. Neurological failure: coma

Oxygen sources
1. Wall oxygen outlets
2. Oxygen cylinders
3. Oxygen concentrators

Mode of delivery (how it is given)
1. Incubator: in neonates and young infants.
2. Hoods or head boxes: in neonates and young infants.
3. Simple oxygen masks: for all ages.
4. Venturi oxygen masks: for all ages it delivers precise oxygen concentration.
5. Nasal prongs: for all ages.
6. Nasopharyngeal catheters.
7. Endotracheal tubes.



Dose: FiO2: fraction of inspired oxygen
1. Treatment start with 40-60% concentration (atmosphere O2 is 21%) then the dose is adjusted according to the response. FiO2 is measured by oxygen analyzer
2. In presence of cyanosis, 100% oxygen is given by tight O2 masks.
3. Use the minimum FiO2 that can achieve acceptable oxygen pressure, It is not necessary to reach the normal pressure.

Precautions
1. Oxygen should be warm and humified.
2. Always follow up with FiO2, stop oxygen when it is no more indicated.

Evaluation of the response to oxygen therapy
1. Clinical response: color and severity of signs of respiratory distress
2. Measurement of arterial oxygen saturation with pulse oximetry.
   - Normal: > 95%
   - Mild hypoxia: 90 - 95%
   - Moderate hypoxia: 85 - <90%
   - Severe hypoxia: <85%.
3. Measurement of arterial blood gasses.

Complications of oxygen therapy
1. Eye toxicity: retinopathy of prematurity.
2. Lung toxicity:
   - Destruction of pneumocytes and decrease surfactant production
   - Bronchopulmonary dysplasia.
3. Oxygen dependency (difficult weaning).

Positive pressure ventilator support : PPVS

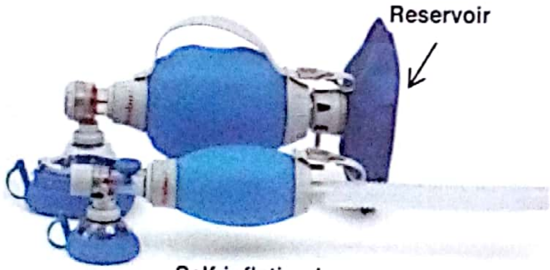
Manual PPVS

Indications

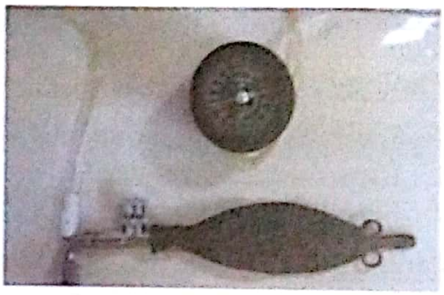
1. During CPR
2. During chest physiotherapy and suction
3. During transport, if portable ventilator is not available
4. Deterioration while on mechanical ventilation

Types of bags: each bag can be used connected to mask or tube

1. **Self-inflating : Ambu bag**
   - **Advantages**
     - It will always be refill after being squeezed even with no compressed gas resource
     - Pressure release valve makes over inflation less likely.
     - Easy to use
   - **Disadvantages**
     - It will inflate even if there is not a seal between the mask and patient face.
     - It requires reservoir to attachment to deliver oxygen 100%, without reservoir it deliver only 40



Self-inflation bag



Flow inflation bag

2. **Flow inflating : anesthesia bag (Jackson –Rees)**
   - **Advantages**
     - Deliver 100% oxygen at all times (once oxygen enters the bag it is not diluted, therefore the same concentration of oxygen that enters the bag is delivered to the patient)
     - Easy to determine when there is a leak on the patient's (bag will not inflate)
     - Stiffness of lungs can be felt when squeezing the lung
   - **Disadvantages**
     - It Require a gas source to inflate.
     - It requires a tight seal between mask and face to remain inflated
     - Usually don't have a safety pop - off (pressure release valve)

Mechanical PPVS

Indications

1. Apnea, hypoxia or hypercarbia , if not responding to simple measures
2. Supportive: after CPR, major surgery, shock or refractory status epilepticus
3. Therapeutic : therapeutic hyperventilation to reduce the increased intracranial tension

Parts of ventilator system: revise clinical book

1. Source of oxygen and compressed air
2. Oxygen blender or mixer
3. Humidifier
4. Patient breathing circuit

Cardiac emergencies

1. Acute congestive heart failure
2. Shock

Acute Congestive Heart Failure

Definition

Failure of heart to perform its function as a pump, that eject blood into the systemic circulation (left ventricle)or into the lungs (right ventricle). In acute congestive heart failure, the clinical manifestations appear acutely

Normal cardiac performance depends on

1. Preload : volume load on the right side of the heart
2. Contractility: myocardial contractility
3. Afterload: pressure load on the left side of the heart
4. Heart rate and rhythm: how fast and hoe regular the heart rate is

Etiology

Preload failure (increased volume load on the right side of heart)

1. Hypervolemia: acute renal failure and excessive IV fluids.
2. Big left to right shunts e.g. PDA, VSD and atrioventricular septal defect.

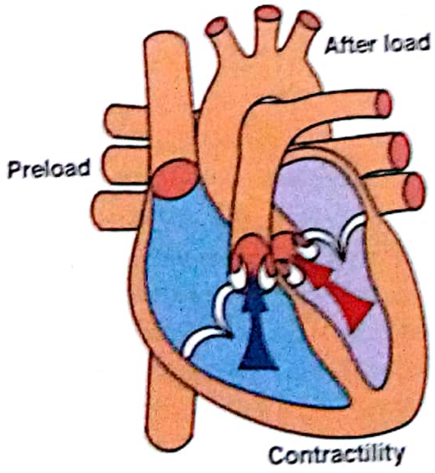
Contractility failure (poor myocardial contractility)

1. Myocarditis (infective-rheumatic).
2. Myocardial ischemia (shock, hypoxia, hypoglycemia and acidosis).
3. Myocardial infarction.

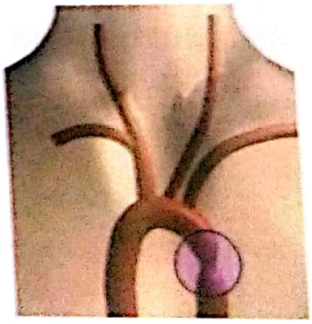
After load failure (pressure load on the left side of the heart)

1. Systemic hypertension: post streptococcal nephritis.
2. Severe Aortic stenosis.
3. Severe coarctation of the aorta.

Arrhythmic failure: severe tachycardia or severe bradycardia.



Hypertensive heart failure


Coarctation of the aorta

Clinical grading

1. **Grade 1: (heart failure only): 3Ts**
   - Tachycardia: compensation to increase cardiac output (CO = stroke volume× heart rate.
   - Tachypnea: pulmonary congestion.
   - Enlarged tender liver: systemic congestion.
2. **Grade II: heart failure and respiratory failure (pulmonary edema)** marked distress and crepitations.
3. **Grade III: heart failure and circulatory failure** (cardiogenic shock): severe hypotension and poor perfusion(cold extremities and skin mottling).

Investigations

1. Chest x ray.
2. ECG: to diagnose arrhythmia.
3. Echocardiography: chamber size and cardiac anomalies.
4. Laboratory: blood gas, CBC, ESR, CRP, and ASOT

Management of acute congestive heart failure

Treatment of heart failure

1. **Fluids and feeding**
   - Fluid restriction: only 60-70% of maintenance.
     Initially when the patient is distressed, oral feeding is avoided because of risk of aspiration. IV fluids are used, then nasogastric feeding.
   - Oral feeding can be tried when the patient is stable, diet should be salt free.
2. **Oxygen therapy correct hypoxia:** given warm and humified with the initial FiO2: 40%
3. **Digoxin therapy to improve myocardial contractility**
   - Dose
     - Digitalizing dose: 0.05 mg/kg (IM or IV) divided into 3 doses (1/2,1/4,1/4) or (1/3,1/3,1/3), after the initial dose the second and the third dose are given after 8 hours and 16 hours .
     - Maintenance dose: 0.01 mg/kg (IM or IV), given in 2 equal doses (every 12 hours). The first of which is given 24 hours after the digitalizing dose
     - Shift to oral Digoxin if oral feeding is tolerated.
   - Precautions
     - Avoid calcium intake and hypokalemia (increase toxicity)
     - Measure serum digoxin level when therapeutic response is unsatisfactory or when toxicity is suspected (vomiting and bradycardia).Toxicity is treated by atropine and phenytoin.
4. **Diuretic therapy**: frusemide 2 mg/kg /day2 to 3 divided doses IM or IV shift to oral diuretics if oral feeding is tolerated and the condition is stable.

Treatment of pulmonary edema

1. Oxygen and diuretic therapy (IV, higher doses).
2. Inotropes: IV digoxin, IV drip of dopamine or dobutamine.
3. Continuous positive airway pressure (CPAP) or mechanical ventilation according to severity.

Treatment of cardiogenic shock

1. Inotropic drugs (IV dopamine: 5-10 µg/kg/min IV or dobutamine 2-8 µg/kg/min IV or both) not digoxin as it is slowly acting and high risk of toxicity
2. After load reducing agents(vasodilators):Captopril : 0.5 to 6 mg/kg/day in 2 to 4 doses

Specific treatment according to the causative disease e.g. rheumatic fever.

Circulatory Failure (shock)

Definition

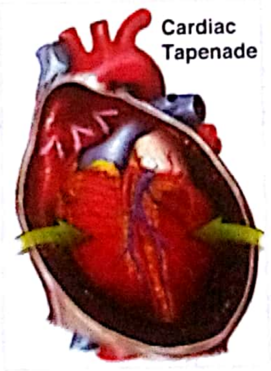
Failure of the circulatory system to maintain tissue perfusion which leads to inadequate delivery of oxygen and nutrients ton tissues (tissues hypoperfusion).

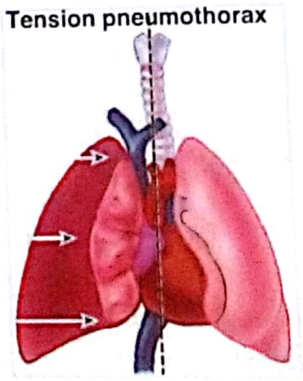
Normal circulation depends on 3 components

1. Blood volume (the fluid).
2. Cardiac function (the pump).
3. Tone of blood vessels (the pipes).

Etiology: S H O C K

1. **Septic shock**
   - Primary septicemia due to fulminant sepsis.
   - Secondary septicemia due to serious focal infection.
2. **Hypovolemic shock: the most common in children**
   - Severe dehydration (severe diarrhea-severe vomiting- diabetic ketoacidosis).
   - Severe hemorrhage (external – internal).
3. **Obstructive shock**
   - Cardiac tamponade due to pericardial effusion.
   - Tension pneumothorax.
4. **Cardiogenic shock**
   - Severe acute heart failure.
   - Late septic shock or any advanced shock
5. **Kinetic (distributive)shock**
   - Neurogenic shock (head trauma).
   - Anaphylatic shock (due to drugs, foods, serum).





Grading

1. **Grade 1: early shock**: peripheral hypoperfusion; tachycardia and peripheral hypoperfusion.
   - Tachycardia is the earliest and most important single sign when evaluating shock.
   - Early shock occurs without hypotension: shock and hypotension are not synonymous.
2. **Grade II: established shock**: arterial hypotension: grade 1 + hypotension.
3. **Grade III: advanced shock**: vital organ hypoperfusion: grade 2 + multiple organ system failure.
4. **Grade IV: irreversible shock**: irreversible cellular damage: grade 3+ refractory acidosis.

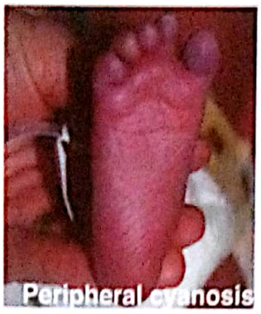
Stages of shock

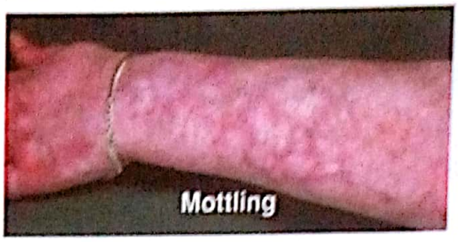
1. **Compensated stage: grade I**
2. **Decompensate stage: grade II, III**
3. **Irreversible stage: stage IV**

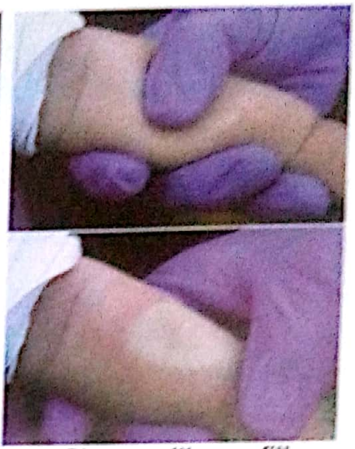
Clinical manifestations of shock in general

Signs of peripheral hypoperfusion

1. Cold extremities and increased core- peripheral temp. difference more than 2 C°.
2. Slow capillary refill (refill in more than 5 seconds).
3. Skin mottling and peripheral cyanosis.






Slow capillary refill

Manifestations of multiple organ system failure

1. Heart: myocardial ischemia, arrhythmia.
2. Brain: hypoxic ischemic encephalopathy
3. Lung: adult respiratory distress syndrome
4. Kidney: acute renal failure
5. Liver: acute hepatic failure.
6. Blood: DIC- thrombocytopenia
7. Metabolic: metabolic acidosis and electrolyte disturbances.

Hemodynamic parameters in different types of shock

	Cardiac output	Systemic vascular resistance After load	Central venous pressure Preload
Hypovolemic	Decreased	Increased	Decreased
Cardiogenic	Decreased	Increased	Increased
Distributive	Increased	Decreased	Decreased

Management

Monitoring

1. Clinical monitoring: heart rate, respiratory rate, blood pressure and urine output.
2. Laboratory: blood gases, electrolytes, blood sugar and cultures.
3. Central venous pressure.

Cardiovascular support

1. Oxygen therapy
2. Preload augmentation
   - IV fluids for dehydration: ringer lactate (crystalloid) 20 ml/kg over 10-15 minutes which can be repeated.
   - Others: colloids as albumin, plasma and whole blood.
3. Contractility augmentation (IV infusion of dopamine, dobutamine or both).
4. After load reduction: vasodilators e.g. (IV infusion of nitroprusside).
5. Treatment of arrhythmia.
   - Treatment of precipitating factors as hypoxia and acidosis
   - Anti-arrhythmic drugs e.g. atropine

Multisystem support: treatment multiple organ system failure.

Specific treatment of the cause.

Neurological emergencies

Coma
Status epilepticus and Febrile seizures see neurology

Coma (brain failure)

Definition

A state of unconsciousness or impaired consciousness in which the patient cannot be completely aroused (awakened) even with painful stimuli (coma is cortical or brain stem).

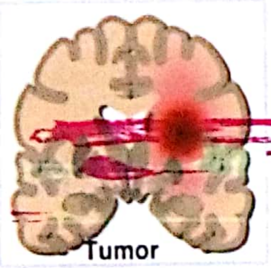
Etiology

Primary brain lesion

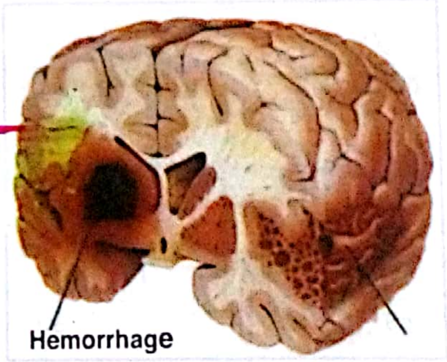
1. Intracranial infections : meningitis, encephalitis and brain abscess
2. Intracranial hemorrhage (traumatic or non-traumatic)
3. Intracranial neoplasm
4. Others: brain infarction – post ictal state following status epilepticus
5. Traumatic brain injury.

Secondary brain lesions

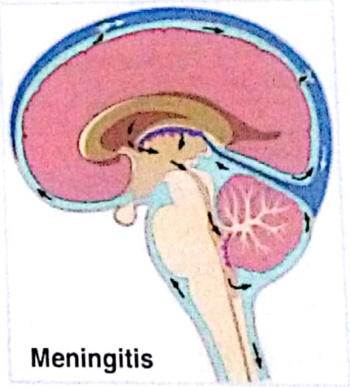
1. Hypoxic encephalopathy: hypoxia – shock- severe anemia.
2. Endogenous encephalopathy: diabetic ketosis- acute renal failure-liver cell failure- severe dehydration- metabolic acidosis and severe electrolytes disturbances.
3. Exogenous encephalopathy: poisoning and drug intoxication



Tumor



Hemorrhage



Meningitis

Clinical assessment

Assessment of the clinical grading of coma

Try to arouse the patient by sequential sensory stimuli to voice, to touch, to pain and observes the patient's response and accordingly identify the grade of coma.

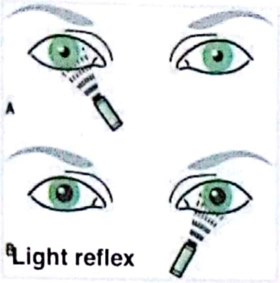
1. **Grade 1: stupor**: the patient can be aroused for only a short period (less than one minute) during which he responds to simple verbal or motor commands. Stupor may alternate with delirium which is a state of mental confusion and motor excitement.
2. **Grade II: light coma**: the patient can be aroused by painful stimuli-He responds to painful stimuli by moaning or withdrawal movement.
3. **Grade III: deep coma**: no response to painful stimuli but still can breathe spontaneously
4. **Grade VI: deep coma with apnea**: no response to painful stimuli with apnea, if not ventilated brain death occurs in 5 minutes

Assessment of level of consciousness: Glasgow coma score

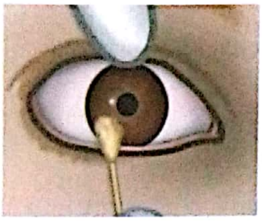
- The scale comprises three tests: eye opening, verbal and motor responses.
- The three values separately as well as their sum are considered.
- The lowest possible GCS (the sum) is 3 (deep coma or death), while the highest is 15 (fully awake person). A score of 8 or less indicates severe neurological injury.

Assessment of level of dysfunction

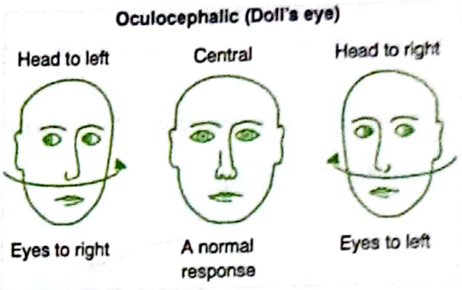
- In cortical lesions, brain stem reflexes (papillary reaction to light, corneal reflex and occulocephalic reflexes) are intact.
- In brain stem lesions: brain stem reflexes are sluggish or lost.



Light reflex



Corneal reflex



Manifestations of acute increased intracranial tension

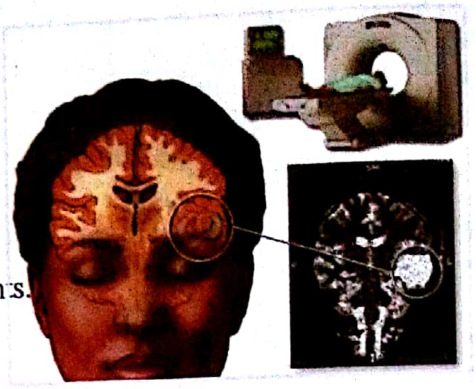
- **Symptoms**
  1. Headache.
  2. Vomiting.
  3. Blurring of vision (papilledema).
- **Signs**
  1. Sluggish pupillary reaction to light.
  2. Hypertonia.
  3. Hyperreflexia.
  4. Hyperventilation.
  5. Hypertension and bradycardia.
  6. Signs of herniation syndromes.

Management of comatose patient

1. Investigations
2. Non-specific neurological support
3. Specific treatment

Investigations

- **Urgent: for all cases**
  1. Blood sugar.
  2. Blood gases.
  3. Serum electrolytes (Na, K, Ca, Mg)
  4. Renal function: blood urea and serum creatinine
  5. Complete blood count.



- **Other investigations: in selected cases**

  Laboratory
  1. CSF if CNS infection is suspected.
  2. Septic screen: ESR, CRP and blood culture.
  3. Liver functions: SGOT, SGPT, and others.
  4. Toxicology screening.
  5. Metabolic screen.
  6. Coagulation studies: PT, PTT and platelet counts.

  Imaging
  1. CT and MRI depend on the clinical suspicion.
  2. Chest X ray.
  3. Chest x ray and abdominal ultrasound.

Non-specific neurological support

- **Initial measures**
  1. **A**: Open the airway and suction the oral cavity and oropharynx.
  2. **B**: Oxygen therapy to correct hypoxia.
  3. **C**: IV line: ringer lactate or saline then maintenance fluid is given.
  4. Control of convulsions if present
     - Specific : control of hypoglycemia and hypocalcemia
     - Nonspecific: IV phenobarbitone, diazepam or phenytoin
  5. Control of increased intracranial tension if present: discuss
     - Decrease fluid intake to 70% of daily requirement.
     - Dexamethasone and Diuretics (furosemide or IV drip Mannitol 20%)
     - Head elevation 30 ° in neutral position.
     - Mechanical hyperventilation to keep pa CO2 25-30 mmHg

- **Other measures**
  1. Care of respiratory system: suction and chest physiotherapy.
  2. Care of GIT: antacids and laxatives.
  3. Care of the eyes: eye ointment to avoid corneal ulceration
  4. Care of the skin: frequent change s of position to avoid bed sores.
  5. Skeletal: physiotherapy to avoid contractures and deformities.
  6. Nutritional support: nasogastric or orogastric tube feeding or total parenteral nutrition,

Specific management. It depends on the cause.

1. Diabetic ketosis: IV insulin and fluids.
2. Intracranial infections: antibiotics or antiviral.
3. Intracranial hemorrhage: neurosurgical consultation and intervention.
4. Exogenous poisoning: gastric lavage, forced diuresis, specific antidote

Hematological emergencies : **Acute hemolytic anemia : hematology P 185**

Metabolic emergencies

1. **Dehydration and rehydration : gastroenterology P 140**
2. **Acute renal failure: nephrology P 213**
3. **Diabetic ketoacidosis: endocrinology, p 165**
4. **Acute hepatic failure: hepatology, P 125**